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...Upfront

The High Costs of Poor Eating Patterns

In the United States, high intakes of fat and saturated fat, and low intakes of calcium and fiber-containing foods such as whole grains, vegetables, and fruits, are associated with several chronic health conditions. In particular, scientists suggest that improved diets could prevent a significant proportion of heart disease, stroke, cancer, diabetes, osteoporosis-related hip fractures, and neural-tube birth defects. A 1993 study in the *Journal of the American Medical Association* estimated that 14 percent of all deaths in the United States could be attributed to poor diets and/or sedentary lifestyles.

Both the aging of the U.S. population and the increasing number of Americans who are overweight are anticipated to increase the prevalence of coronary heart disease, some types of cancer, stroke, and diabetes—with adverse consequences for health-care expenditures and quality of life.

The costs associated with these health conditions are substantial. USDA's Economic Research Service (ERS) estimated that $71 billion in medical costs, lost productivity resulting from disability, and premature deaths in 1995 could be attributed to diet-related coronary heart disease, cancer, stroke, and diabetes. Medical costs at $34 billion accounted for nearly half of that total, followed by premature deaths and lost productivity resulting from disability.

The ERS study notes that the estimated $71 billion in costs attributed to diets underestimate the true costs associated with unhealthy diets. For example, the study did not include diet-related costs associated with osteoporosis, hypertension, and obesity. In addition, the study used very conservative estimates to value premature deaths.

Despite efforts by public and private agencies to educate consumers about how to achieve healthier diets, Americans are far from meeting these recommendations. Research by USDA's Center for Nutrition Policy and Promotion indicates that in 1994-96, only about 12 percent of Americans 2 years and older had diets that met at least 8 of 10 nutritional recommendations from the *Dietary Guidelines for Americans* and the Food Guide Pyramid.

How to motivate consumers to improve their diets? As the articles in this issue of *FoodReview* illustrate, food choices involve a complex process in which nutrition knowledge competes with myriad other factors, such as income, tastes, habits, attitudes, prices, convenience, and advertising. The prevalence of dining out presents special concerns, as away-from-home foods are generally higher in fat, saturated fat, and cholesterol, and lower in fiber and calcium. Also, consumers appear to be less nutritionally vigilant in their food choices when eating out.

Although researchers have long known that it is difficult to get people to change their food consumption patterns, research now makes clear that the costs associated with not changing current food consumption patterns are substantial.

Elizabeth Frazão
Agricultural Economist
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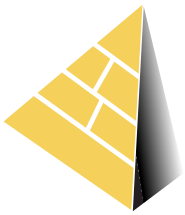
Inside...



The Diet Quality Balancing Act

Also Inside...

...Symbolizes topics linked to the Food Assistance and Nutrition Research Program—a comprehensive program that addresses the Nation's critical food assistance and nutrition policy needs. For more information, visit the program's Briefing Room on the Internet: www.econ.ag.gov/briefing/foodasst

Popularity of Dining Out Presents Barrier to Dietary Improvements

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Americans are dining out more often than ever, boosting the amount spent at eating places from 26 percent of food expenditures in 1970 to 39 percent in 1996. This trend may lower the nutritional quality of consumers' diets, since food away from home is generally higher in fat and saturated fat, and lower in fiber and calcium than is food at home.

Food at home is that purchased at retail stores; food away from home consists of foods obtained from foodservice and entertainment establishments—see box for more details.

An analysis of USDA's food intake survey data covering the past two decades allowed us to compare the nutritional quality of foods at and away from home and examine how it has changed over time. This article focuses on nutrients of current public-health concern: high intake of total fat, saturated fat, cholesterol, and sodium, and low intake of fiber, calcium, and iron.

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Comparisons are based on the nutrient density of foods at and away from home, which measures the amount of a nutrient or food component per 1,000 calories provided by a food. Nutrient density for fat and saturated fat reflects the proportion of total calories from these two nutrients, because dietary recommendations for fat and saturated fat are expressed in terms of total calories consumed.

For each nutrient or food component, we also devised a measure we term "benchmark" density. Obtained by dividing the recommendation for a given nutrient or food component (table 1) by an individual's reported caloric intake in 1,000 calories, the benchmark density represents the nutrient density an individual's diet would have to attain to meet the dietary recommendation at the individual's caloric intake level. Because caloric intake varies over time, benchmark density also varies from year to year.

More Frequent Snacking and Dining Out

Over the past two decades, the number of meals consumed has remained fairly stable at 2.6-2.7 per person per day (table 2). However, snacking has increased—from less than once a day in 1987-88 to 1.6 times a day in 1995.

The proportion of meals away from home increased from 16 percent in 1977-78 to 29 percent in 1995, and the proportion of snacks away from home rose from 17 to 22 percent. The frequency of dining out increased by more than two-thirds over the past two decades, rising from 16 percent of all eating occasions (meals and snacks) in 1977-78 to 27 percent in 1995.

Average intake away from home rose from 18 percent of total calories in 1977-78 to 34 percent in 1995 (table 3). In 1977-78, each percent of eating occasion away from home provided an average of 1.13 percent of total calories, suggesting that when eating out people are either eating more, eating higher caloric foods, or both than when they eat at home. The caloric content of away-from-home eating occasions relative to home eating occasions grew even higher in recent years, with each percent of eating occasion away from home accounting for 1.26 percent of total calories in 1995. While fast-food places and restaurants each accounted for 3 percent of caloric intake in 1977-78, their shares increased to 12 percent and 8 percent, respectively, in 1995. The share of total caloric intake consumed at school has remained stable over the past two decades at 2-3 percent.

Declining Proportion of Calories From Fat and Saturated Fat

According to the *Dietary Guidelines for Americans,* fat intake should be limited to 30 percent or less of total calories, and saturated fat should account for less than 10 percent of total calories. These recommendations represent the benchmark densities for fat and saturated fat.

Over the past two decades, Americans have made appreciable progress in reducing the fat density in the foods they consume. Fat provided an average of 33.6 percent of total calories in 1995—albeit still higher than the recommended limit (see chart page), this is down considerably from 41.1 percent in 1977-78. In the earlier period, both home foods and away-from-home foods provided slightly more than 41 percent of their calories from fat. Since then, the fat density of home foods declined steadily to 31.5 percent by 1995, but that of away-from-home foods declined slightly to 37.6 percent.

Restaurant foods had a considerably higher fat density than either fast foods or school foods in 1977-78, with fat providing over 46 percent of calories (see chart page). Although the fat density of restaurant foods declined to 40.1 percent by 1995, this was still higher than the fat densities of fast foods or school foods. The fat density of fast foods also declined (from 41.6 percent in 1977-78), and has fluctuated at slightly below 40 percent of total calories since 1987-88. The fat density in school foods declined steadily from 40.1 percent to 35.7 percent between 1977-78 and 1995.

As with fat, the saturated fat density of American diets has also declined steadily since 1987-88, when it was first measured (see chart page). Home foods typically have had a lower saturated fat density than away-from-home foods, and the saturated fat density of both types of foods experienced similar declines through 1994. The saturated fat density of food at home continued to decline between 1994 and 1995, but that of food away from home rose slightly.

Data Cover 1977 Through 1995

The findings reported in this article are based on almost 20 years' worth of data from USDA's food consumption surveys. We analyzed data from seven year-round national surveys of individual food intake, including the Nationwide Food Consumption Survey (NFCS) 1977-78, NFCS 1987-88, the Continuing Survey of Food Intakes by Individuals (CSFII) 1989, CSFII 1990, CSFII 1991, CSFII 1994, and CSFII 1995.

Data collected earlier than 1977 were excluded because they were not comparable to later surveys. For example, the 1965 data included only the spring quarter and only "housekeeping households"—households with at least 1 person having 10 or more meals from the household food supply during a 7-day period. The CSFII 1985-86 data also were excluded because they did not include all age/gender groups. The CSFII 1996 was in progress when this study was underway.

Only the first day of data from each survey were analyzed to form the basis for a consistent comparison. Because the *Dietary Guidelines for Americans* are not aimed at individuals under age 2, those children were excluded. Pregnant and lactating women were also excluded because their dietary needs differ considerably from the rest of the population.

Underreporting is a potential problem with dietary recall surveys such as NFCS and CSFII, as respondents may forget to record the donut they ate on the way to work or the candy bar snack in the afternoon. Therefore, energy and nutrient intakes in NFCS and CSFII may represent the lower limits of actual intakes. However, improvements in data-probing techniques have provided more accurate intake estimates. In fact, some of the increases in energy and nutrient intakes reported in USDA surveys could be attributed to improved survey methodology.

We define home foods and away-from-home foods based on where the foods are obtained, not where they are eaten. Food at home consists of foods purchased at a retail store, such as a grocery store, a convenience store, or a supermarket. Food away from home consists of foods obtained at various eating places (mainly food-service establishments). Our distinction between home foods and away-from-home foods is related to the degree of control a consumer has over the nutritional content of the food.

Sources of away-from-home foods are grouped into four categories: fast-food places, schools, restaurants, and others. Fast-food places include self-service restaurants and carryout places. Schools— a separate category for children between the ages of 2 and 17—also include daycare centers and summer camps. Restaurants are those eating places with waiter service. Others is a catchall category that includes cafeterias, residential dining facilities, bars, soup kitchens, shelters, Meals on Wheels and other community feeding programs, vending machines, and meals eaten in someone else's home or received as a gift. Meals and snacks consisting of a combination of away-from-home and home foods are classified according to the component that contributes the most calories to that particular eating occasion.

Table 1
Recommended Daily Intakes of Selected Dietary Components

Gender and age	Calories[1]	Fat[2]	Saturated fat[2]	Cholesterol[3]	Sodium[4]	Fiber[5]	Calcium[6]	Iron[6]
	Number	*Percent*	*Percent*	*Milligrams*	*Milligrams*	*Grams*	*Milligrams*	*Milligrams*
Males and females:								
2-3	1,300	<30	<10	300	2,400	Age+5/day	800	10
4-6	1,800	<30	<10	300	2,400	Age+5/day	800	10
7-10	2,000	<30	<10	300	2,400	Age+5/day	800	10
Males:								
11-14	2,500	<30	<10	300	2,400	Age+5/day	1,200	12
15-18	3,000	<30	<10	300	2,400	Age+5/day	1,200	12
19-20	2,900	<30	<10	300	2,400	Age+5/day	1,200	10
21-24	2,900	<30	<10	300	2,400	11.5/1,000 kcal	1,200	10
25-50	2,900	<30	<10	300	2,400	11.5/1,000 kcal	800	10
51 and over	2,300	<30	<10	300	2,400	11.5/1,000 kcal	800	10
Females:								
11-14	2,200	<30	<10	300	2,400	Age+5/day	1,200	15
15-18	2,000	<30	<10	300	2,400	Age+5/day	1,200	15
19-20	2,000	<30	<10	300	2,400	Age+5/day	1,200	15
21-24	2,000	<30	<10	300	2,400	11.5/1,000 kcal	1,200	15
25-50	2,000	<30	<10	300	2,400	11.5/1,000 kcal	800	15
51 and over	1,900	<30	<10	300	2,400	11.5/1,000 kcal	800	10

Notes: [1]National Research Council's Recommended Energy Allowances. [2]*Dietary Guidelines for Americans.* [3]U.S. Food and Drug Administration's (FDA) Daily Values. [4]National Research Council's recommendations. [5]American Health Foundation's recommendation for "age plus five" per day and FDA's Daily Value for 11.5 grams per 1,000 calories. [6]National Research Council's Recommended Daily Allowances (1989).

In 1987-88, the saturated fat density of restaurant and fast foods was similar—and higher than school foods (see chart page). The saturated fat density of both restaurant foods and fast foods declined sharply between 1987-88 and 1989. The saturated fat density of restaurant foods continued to decline during the first half of 1990's, while the saturated fat density in fast foods rose. The saturated fat in school foods rose from 13.9 percent of total calories in 1987-88 to 16.1 percent in 1990, then declined steadily to 14.2 percent in 1995—higher than the saturated fat density of foods at restaurants and fast-food places.

The fat and saturated fat densities of food at and away from home have been declining, although the away-from-home sector has shown less improvement. With the increasingly important role of the away-from-home sector in the overall diet, the fat and saturated fat density of food away from home will be a key to consumers' progress in reducing their intakes of fat and saturated fat.

Cholesterol Levels Falling Faster for Home Foods

Many health authorities recommend that daily cholesterol intake should not exceed 300 milligrams (mg), which is used in the U.S. Food and Drug Administration's (FDA) Daily Values (DV) for nutrition labeling. Because this recommended cholesterol intake is fixed regardless of caloric intake and because average caloric intake has increased since 1987-88, the benchmark cholesterol density has declined since then (see chart page).

Average cholesterol intake has declined since 1987-88 (when the cholesterol content of Americans' diets was first measured) from 286 mg to 268 mg in 1995. Between 1987-88 and 1990, the cholesterol density of home foods was actually higher than that of away-from-home foods. However, the relationship reversed after 1990, indicating that consumers have been more successful in reducing their cholesterol intake from home foods than from away-from-home foods. Although restaurant foods have a higher cholesterol density than food from fast-food places and schools, all three sources have experienced an overall downward trend (see chart page).

Cholesterol levels are of particular concern for teenage boys and men. Male adolescents and adults tend to eat more than others, yet they face the same recommended cholesterol intake as others. In 1995, males ages 12-39 consumed an average of 2,763 calories per day, which translates into a benchmark cholesterol density of 109 mg per 1,000 calories. That compares with cholesterol densities for home and away-from-home foods eaten by males ages 12-39 of 122 and 127 mg, respectively. To meet the cholesterol recommendation, male adolescents and adults have to watch the cholesterol content of their food choices both at and away from home. Consumers must be especially vigilant at restaurants, where cholesterol density was 176 mg in 1995.

Sodium Gap Worsening

The National Academy of Sciences' *Diet and Health Report* recommends that consumption of sodium not exceed 2,400 mg per day, regardless of age and gender. As with cholesterol, individuals who consume more calories have lower benchmark sodium density values than do those getting fewer calories. Sodium intake reported in the surveys includes sodium occurring naturally in foods, added in food processing, and used in food preparation. It does not include sodium added at the table. The surveys first measured sodium content in 1987-88.

Consumers consume excess sodium (see chart page). Because of rising caloric intake, sodium benchmark density has declined over time, indicating that Americans need to limit the sodium density of their diets more than they did before when it was already too high. The sodium densities of home and away-from-home foods are fairly similar, and both are substantially higher than the benchmark density. More importantly, the gap between the sodium density and the benchmark density has widened during the past two decades. As a result, those ages 2 and older who meet the sodium recommendation declined from 41 percent in 1987-88 to 34 percent in 1995.

The sodium density of restaurant foods rose sharply between 1989 and 1990, but it has declined since 1991 (see chart page). The sodium densities of fast foods generally rose during the past 10 years, while that of school foods declined during the late 1980's, but rose back to the 1987-88 level in 1994-95.

Foods Away From Home Lower in Calcium

The 1989 Recommended Daily Allowances (RDA) for calcium used in this analysis were 1,200 mg for those ages 11-24 and 800 mg for all others. In August 1997, the Institute of Medicine of the National Academy of Sciences issued new dietary recommendations for several nutrients, including calcium. The report raises the recommended calcium intakes for many Americans, especially children ages 9 and older and adults ages 25 and older (see "Milk and Milk Products: Their Importance in the American Diet," elsewhere in this issue). Insufficient calcium intake is a more severe problem facing females (adolescents and adults) because of their higher calcium requirements and their lower food consumption. In 1995, for example, only 18 percent of adolescent girls ages 12-17 met the 1989 calcium RDA's.

Calcium density of all foods rose between 1977-78 and 1990 and then declined (see chart page). Meanwhile, rising caloric intake since 1987-88 is associated with a declining benchmark calcium density. The result is that more people are coming closer to the recommendation, as seen in the gap between average calcium density and benchmark calcium density becoming narrower over time. In 1995, 36 percent of individuals ages 2 and older met the calcium RDA, up from 31 percent in 1977-78.

However, the trend toward increased consumption of fast foods or restaurant foods will slow progress in reaching calcium intake recommendations. Calcium density in home foods generally rose, while that in away-from-home foods declined slightly. In 1995, the calcium density of home foods was 425 mg per 1,000 calories, fairly close to the benchmark density. Away-from-home foods had a calcium density of 343 mg, which was 21 percent below the benchmark level.

The calcium density of school foods has always been considerably higher than that of restaurant or fast foods—and even home foods (see chart page). School foods had a calcium density of 689 mg in 1995—62 percent higher than that of home foods, almost double that of fast foods, and more than double the level in restaurant foods.

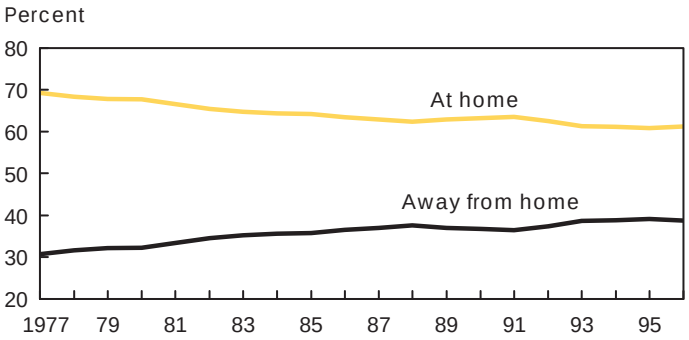
Dietary Fiber Is Low, Regardless of Where Food Is Bought...

The American Health Foundation recommends a dietary fiber intake of "age plus five" for those ages 2-20, and the FDA uses a DV of 11.5 grams per 1,000 calories. We use the "age plus five" recommendation for those ages 2-20 years, and the FDA's DV for those over age 20.

Over the past decade, fiber densities of home and away-from-home foods have increased slightly, but they still remain far below the benchmark (see chart page). Home foods had a fiber density of 8.1 grams per 1,000 calories in 1995,

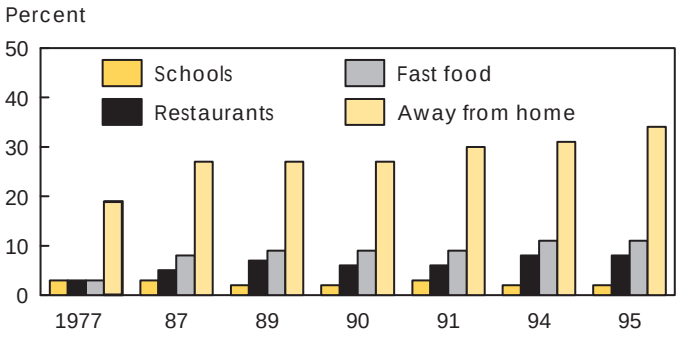
Food Away From Home Is Generally Higher in Fat and Saturated Fat, and Lower in Fiber and Calcium Than Is Food at Home

Share of Food Budget



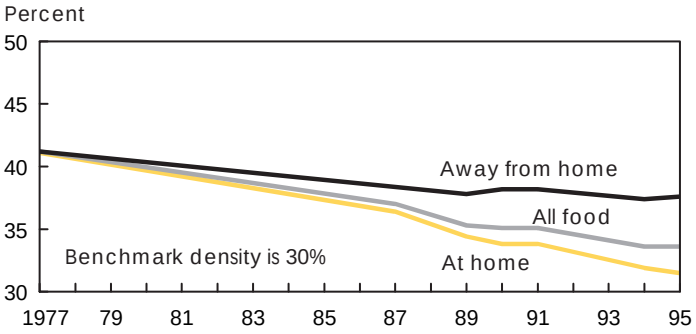
All foods

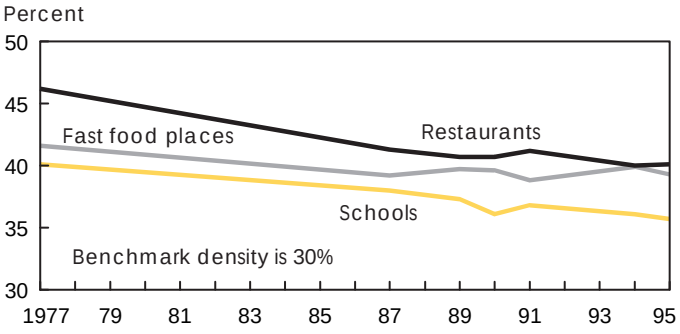
Proportion of Calories



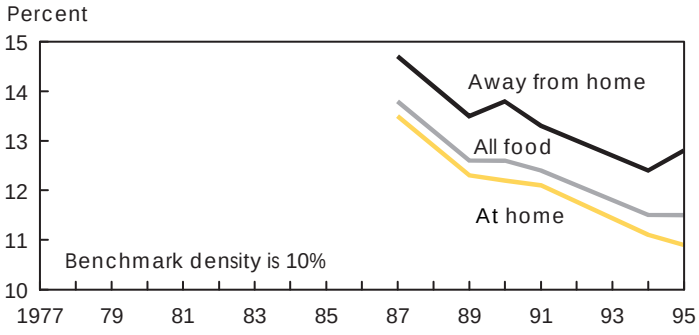
Away from home

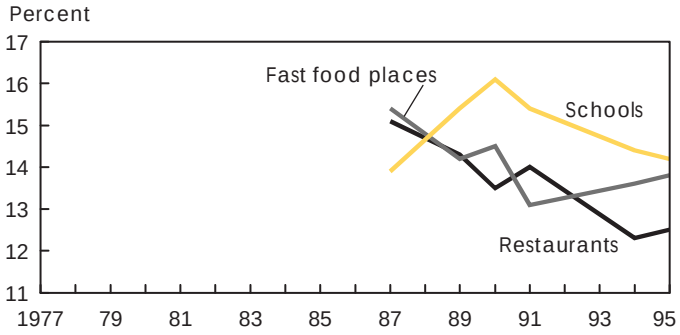
Share of Calories From Fat



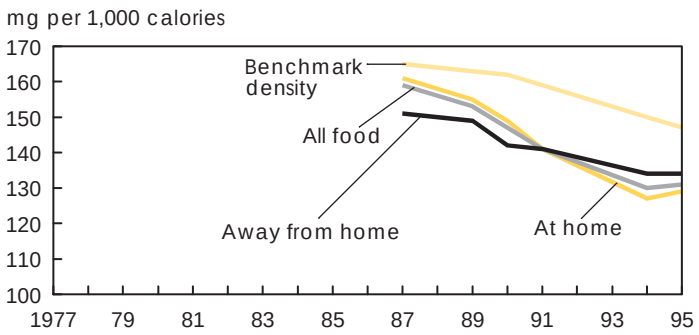


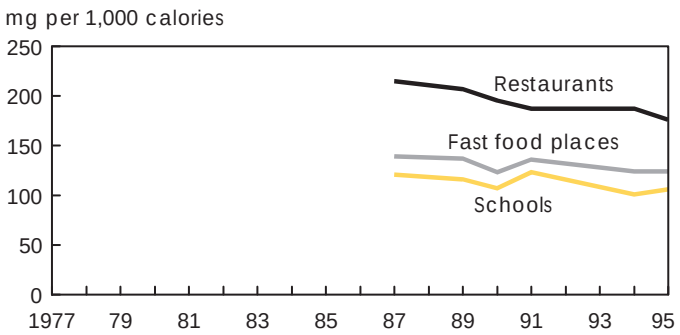
Share of Calories From Saturated Fat





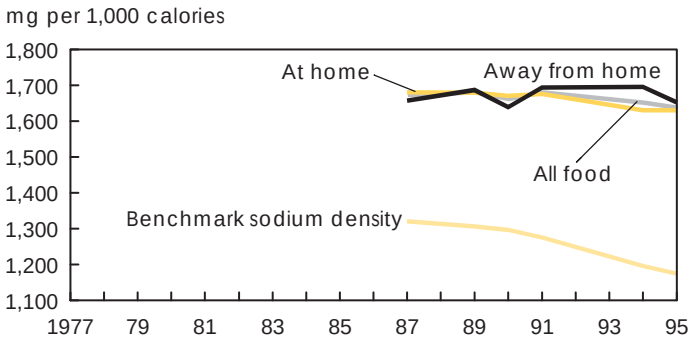
Cholesterol Density



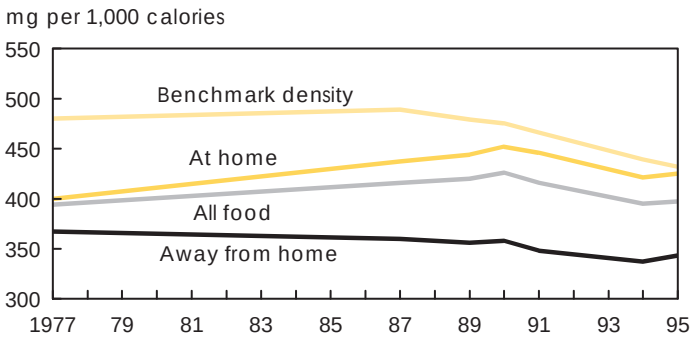


All foods

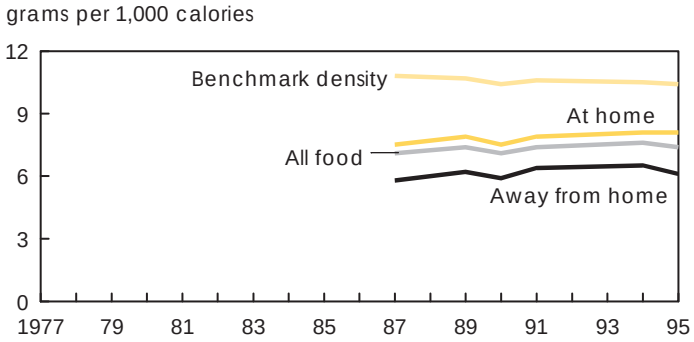
Sodium Density



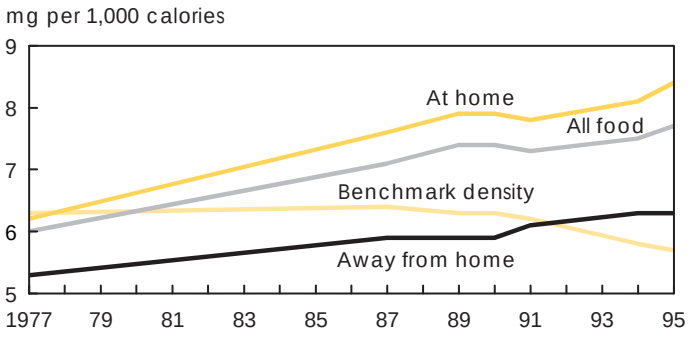
Calcium Density



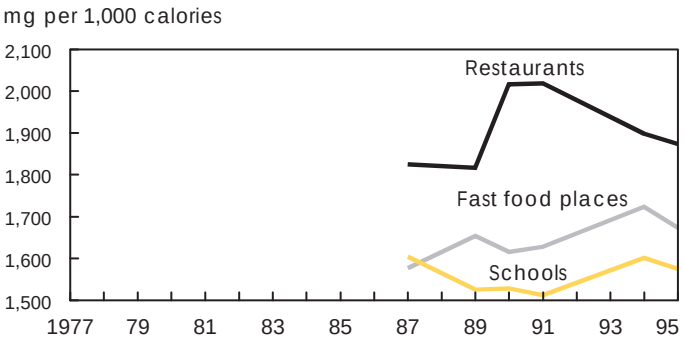
Fiber Density

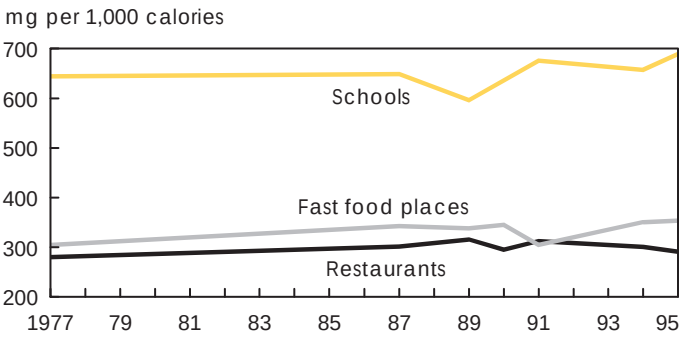


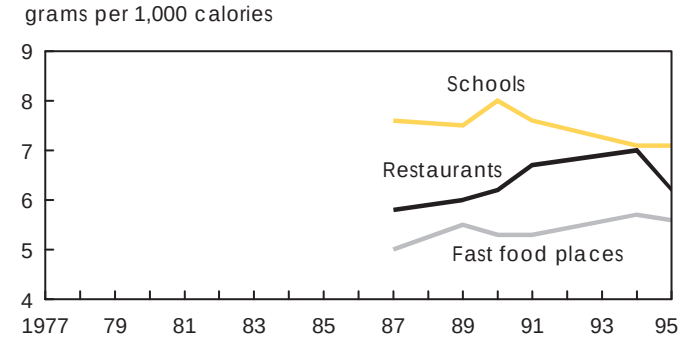
Iron Density

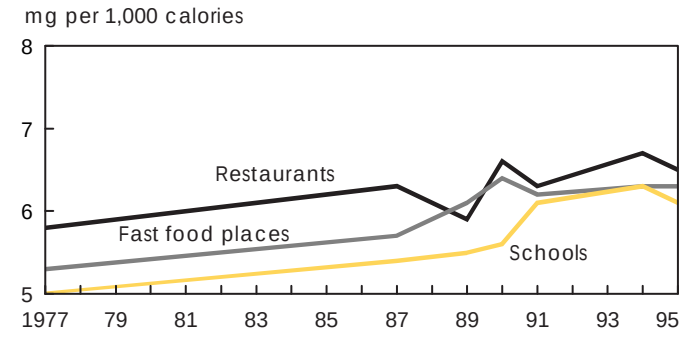


Away from home









Note: Share of food budget is based on Putnam and Allshouse, 1996. All others are compiled by ERS from NFCS 1977-78, NFCS 1987-88, CSFII 1989-91and CSFII 1994-95, first-day intake data.

Table 2
Snacking and Eating Out Have Become Popular

Eating occasion	1977-78	1987-88	1989	1990	1991	1994	1995
				Number			
Total meals	2.7	2.6	2.6	2.6	2.6	2.7	2.6
Total snacks	1.1	.9	1.2	1.2	1.4	1.5	1.6
				Percent			
Meals:							
At home	84	76	76	77	73	72	71
Away from home[1]	16	24	24	23	27	28	29
Snacks:							
At home	83	80	80	82	82	79	78
Away from home[1]	17	20	20	18	18	21	22
All eating occasions:							
At home	84	77	77	78	76	74	73
Away from home[1]	16	23	23	22	24	26	27
Restaurants	2	4	4	4	4	6	5
Fast foods	3	7	7	7	7	8	9
Schools[2]	3	2	2	2	3	2	2

Notes: [1]Away from home is the aggregate of fast foods, restaurants, schools, and others not reported. [2]Schools are classified as a separate category for children only. Sources: Compiled by ERS from Nationwide Food Consumption Survey 1977-78 and 1987-88, Continuing Survey of Food Intakes by Individuals 1989-91 and 1994-95, first-day intake data.

about three-fourths of the benchmark level, and away-from-home foods had a fiber density of 6.1 grams. In 1995, fiber intake averaged 15.2 grams per day, and only 24 percent of individuals ages 2 and older met the fiber intake recommendations.

School foods have had the highest fiber density of the three main sources of food away from home (see chart page). However, after reaching its peak at 8.0 grams per 1,000 calories in 1990, the fiber density of school foods declined to 7.1 grams in 1994 and 1995. The fiber density of fast foods has shown a general upward trend; however, its 5.6 grams in 1995 was the lowest among all foods. The fiber density of restaurant foods increased from 5.8 grams in 1987-88 to 7.0 grams in 1994, then fell to 6.2 grams in 1995.

The increased popularity in dining at fast-food places and restaurants may reverse the little progress Americans have made in increasing their fiber intake.

...But Iron Is Up

The RDA's for iron are 12 mg for males ages 11-18, 15 mg for females ages 11-50, and 10 mg for others ages 2 and older. Over the past two decades, iron density has risen faster for food at home than for food away from home (see chart page). The increased iron density in home foods can be attributed partially to increased consumption of iron-fortified breakfast cereals. Mean daily dietary iron consumption of those ages 2 and above has exceeded the RDA's since 1987-88. In 1995, 61 percent of all individuals ages 2 and older met their dietary iron RDA's, compared with only 42 percent in 1977-78.

The iron density of foods served at fast-food places, schools, and restaurants has risen over the past two decades (see chart page). Although restaurant foods have a higher iron density than fast foods or school foods, the differences in the iron density between these three major away-from-home food sources have narrowed over time.

While most people consume the recommended amounts of dietary iron, low intake is common when it comes to adolescent girls and women—those with the highest requirements and typically low food consumption. Only one in every three women ages 18-39 met their iron RDA's in 1995. Home foods consumed by those women had an iron density of 8.2 mg per 1,000 calories and away-from-home foods contained 6.0 mg of dietary iron,

Table 3
Food Away From Home Accounted for a Third of Total Caloric Intake in Recent Years

Caloric intake	1977-78	1987-88	1989	1990	1991	1994	1995
				Number			
Average intake	1,876	1,807	1,837	1,853	1,883	2,006	2,043
				Percent			
Meals:							
Share of total calories:							
At home	82	73	73	74	71	69	66
Away from home[1]	18	27	27	26	29	31	34
Restaurants	3	5	7	6	6	8	8
Fast foods	3	8	9	9	9	11	12
Schools[2]	3	3	2	2	3	2	2

Notes: [1]Away from home is the aggregate of fast foods, restaurants, schools, and others not reported. [2]Schools are classified as a separate category for children only. Sources: Compiled by ERS from Nationwide Food Consumption Survey 1977-78 and 1987-88, Continuing Survey of Food Intakes by Individuals 1989-91 and 1994-95, first-day intake data.

compared with a benchmark density of 8.4 mg. Therefore, the increased popularity of dining out may exacerbate the problem of low iron intake among some women.

New Strategies Needed To Improve Food Choices When Eating Out

Over the past two decades, Americans have progressed markedly in reducing the density of fat, saturated fat, and cholesterol in their diets and in increasing their iron density. Increasing iron densities of foods at and away from home have resulted in a higher proportion of Americans consuming sufficient dietary iron. However, low iron intakes remain a problem for many adolescent girls and women.

However, little progress has been made in increasing the fiber or calcium density or in reducing the sodium density. Although home foods are typically more fiber- and calcium-dense than are away-from-home foods, the fiber and calcium density of home foods has remained below the benchmark density. School foods have consistently been more calcium-dense than home foods throughout the past two decades. However, the calcium density of school foods is lower for older children, suggesting that children choose foods less dense in calcium as they grow older. This points out the importance of educating children in improving their food choices at school and elsewhere.

There has been little reduction in the sodium density of foods, and overall food consumption as measured by caloric intake has increased. As a result, more people exceeded the recommendations for sodium intake in 1995 than in 1987-88. Although away-from-home foods have a slightly higher sodium density than do home foods, the difference is so small that sodium intake has to be reduced greatly at and away from home in order to meet recommendations.

Away-from-home foods generally contain more of the nutrients overconsumed and less of the nutrients underconsumed in the United States. The fat and saturated fat density of away-from-home foods has not declined as much as for home foods. The cholesterol density of restaurant foods remains considerably higher than that of other food sources. As a result, the increased popularity of dining out presents a barrier to dietary improvements—particularly in terms of reducing intakes of calories, fat, saturated fat, and cholesterol.

Since the trend of eating out more is not expected to reverse, nutrition policy, education, and promotion strategies are needed to improve the nutritional quality of food choices made away from home. In the case of school meals, the Healthy Meals for Healthy Americans Act of 1994 (Public Law 103-448) now requires meals served as part of the National School Lunch and School Breakfast Programs to meet the *Dietary Guidelines for Americans*. But no meal, however healthy, will have an effect on health unless it is eaten. Team Nutrition is USDA's national program developed to help schools successfully implement the *Dietary Guidelines for Americans* in school meals. Team Nutrition also provides nutrition education through schools,

families, the community, and the media to motivate children to make healthier food choices in and outside of school.

In the case of meals eaten at restaurants, fast-food places, and other foodservice establishments, however, consumer demand is the key for change. Currently, it appears that consumers are less likely to value the nutritional properties of foods when eating away from home than when eating at home. Several fast-food chains have introduced reduced-fat hamburgers, for example, but later withdrew them from the menu because of low sales. And, a number of restaurant operators claim that although consumers say they want healthful foods, that is not what they typically order.

Perhaps consumers consider eating out to be an occasional treat that does not have the same effect on overall diet as food at home does. This attitude may have been reasonable 20 years ago when eating out was much more infrequent, but that belief has become increasingly inappropriate as eating out has become more common. Consumers may not realize the extent to which eating out has become a part of their usual diets or its effect on overall diet quality. To the degree that consumer attitudes are a barrier to change (see "Matching Perception and Reality in Our Diets," elsewhere in this issue), nutrition education and promotion strategies are needed to inform consumers of the effect of food away from home on overall diet quality and to help create positive attitudes about making healthy food choices when eating out.

Another factor may be related to differences in information. When eating out, consumers are less likely to know about the ingredients, preparation methods, and nutritional quality of foods purchased, especially foods they may not be used to preparing themselves. Nutrition information about foods purchased away from home is required only if specific health or nutrition claims are made about that food; and even then, complete nutrition information on the food item is not required. It has been argued that providing accurate nutrition information on foodservice items would be much more difficult and more of a constraint on businesses than is labeling standard retail packaged foods. More information on how providing nutritional information in restaurants and other foodservice establishments affects consumers' behavior and the potential costs and benefits of nutrition labeling in those settings would be useful for guiding policy decisions.

Provision of nutrition information may have played a role in influencing consumers' food choices at home (see "Food Companies Spread Nutrition Information Through Advertising and Labels," elsewhere in this issue). Between 1977-78 and 1994-95, there have been notable changes in the nutritional composition of foods at home. In particular, fat density declined steadily from 41 percent of calories from fat in 1977-78 to 34 percent in 1994-95. In contrast, there has been less change in the nutritional composition of foods away from home.

With eating out now playing an increasingly large role in the American diet, more nutrition-intervention activities are needed to focus on improving the quality of food away from home and consumers' food choices when eating out.

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Away-From-Home Foods Increasingly Important to the Quality of the American Diet
(AIB # 749)

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Prices and Incomes Affect Nutrients Consumed

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Americans are increasingly concerned about their nutritional and health status. There appears to be a trend toward more healthful diets, as measured by increased consumption of lowfat and nonfat foods and leaner cuts of meat. But a considerable gap still exists between dietary recommendations and consumers' nutrient intakes. According to the *Third Report on Nutrition Monitoring in the United States*, many Americans' diets remain too high in fat, saturated fat, and cholesterol and too low in fiber, calcium, and iron.

Since the release of the *Dietary Goals for the United States* in 1977 and the most recent 1995 *Dietary Guidelines for Americans*, Federal nutrition-education efforts have provided advice to help Americans make more healthful food choices. The Food Guide Pyramid helps consumers implement the Dietary Guidelines. These education efforts assume that consumers make food choices based on health concerns.

But economic factors, such as food prices and consumers' incomes, also are important influences in the decision whether to purchase a particular food, how often, and how much to purchase. For example, if the price of beef goes up while the price of chicken remains the same, consumers likely will buy less of the relatively more expensive beef and buy more of the relatively less expensive chicken. Consumption of other foods could also be affected. If consumers buy less beef, such as hamburger meat, they also buy less cheese and fewer hamburger rolls because of their complementary uses in cheeseburgers.

A change in the price of a particular food or in per capita income affects the quantities demanded for all foods through the interdependent relationships between foods. Because different foods provide different nutrients, changes in food purchases due to food prices or consumer incomes likely translate into changes in nutrient availability and thus affect the nutritional quality of consumers' diets.

This analysis provides a way to determine how a price or income change affects the availability of a particular nutrient, as well as the simultaneous effects on other nutrients. These estimated price and income effects help policymakers understand what changes might occur in the amount of different nutrients consumed if a policy that reduced supplies of a particular food caused its price to increase. The analysis also provides insights as to how policies that affect incomes may affect nutrient intakes.

This article uses average per capita food consumption, or "disappearance," data for 1989 to 1993. The data represent the quantities of food supplies moving through U.S. marketing channels. The foods are reported mostly in their raw commodity form, such as wheat flour or meats in retail-weight equivalents, rather than as finished food products, such as baked goods or ground round. The data, therefore, measure average food consumption at the aggregate level, rather than at the individual or household level. Food prices used in this article are obtained from the U.S. Department of Labor.

All foods were classified into seven groups: grains, which include wheat flour, rice, and cereal products; vegetables, including potatoes and fresh and processed vegetables; fruits, including fresh and processed fruits and fruit juices; dairy, including fluid milk, evaporated and dry milk, cheese, and frozen dairy products; meats, including red meats, poultry, fish, eggs, dry beans, and nuts; fats, including butter, mar-

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garine, lard, and salad and cooking oils; and sweeteners, which include sugars and corn sweeteners.

Nutrient values were compiled from USDA's 1996 Nutrient Data Base SR 11 on the nutrient content of 5,635 food items. This article focuses on 12 nutrients: food energy (calories), protein, fat, saturated fat, cholesterol, dietary fiber, vitamin A, vitamin C, vitamin E, folate, calcium, and iron.

Sources of Nutrients in the Food Supply

No single food group provides all the nutrients and other healthful substances that people need (table 1). Energy is provided mainly by grains, meats, and fats, with each group contributing slightly less than a quarter of the total energy available. Major sources of protein are meats (48 percent), and dairy and grains (about 25 percent each). Fat comes mostly from the fats group (51 percent) and meat group (33 percent), with meats providing 35 percent of total saturated fat and most of the cholesterol (75 percent).

More than 50 percent of dietary fiber comes from grains, with an additional 46 percent provided by vegetables and fruits. Major sources of vitamin A are vegetables (37 percent) and dairy (31 percent), while fruits and vegetables contribute 92 percent of total vitamin C. The largest share of folate (a B-vitamin) comes from grains, although vegetables, fruits, dairy, and meats also contribute considerable amounts. Vitamin E comes mainly from fats (83 percent), while dairy is the major source of calcium (contributing 84 percent of the total). Grains and meats contribute about 62 percent and 23 percent, respectively, of iron.

As stated, the estimates (table 1) are based on foods in their raw commodity form rather than as final food products. For example, the grain group is naturally low in fat, and in its raw commodity form, provides less than 2 percent of the total fat available for consumption at this aggregate level. Nutrient shares would differ considerably at the final food level, since preparation methods that incorporate added fats may result in a high fat content for many of the final grain products (such as baked goods). In this analysis, because of difficulty in measuring the amount of oil used in frying that may be thrown away after cooking, the fats and oils used in baked goods and other processed foods are counted in the fats group.

Food Choices Influenced by Prices and Incomes

Consumers adjust their food choices to changes in prices and their incomes. The adjusted food choices are then translated into changes in nutrient levels. We used a model to estimate how nutrient levels change in response to changes in the price of a particular food group. The model shows effects from those foods whose prices change, effects on other foods, and effects from changes in income.

We estimated the percentage change in the availability of 12 nutrients in response to a 10-percent decrease in the price of any one food group, holding the prices of other food groups constant (table 2). All the prices of food commodities within a food group are assumed to

Table 1
A Mix of Food Groups Are Necessary To Get All the Nutrients Needed for a Balanced Diet

Nutrient	Grains	Vegetables	Fruits	Dairy	Meats	Fats	Sweeteners
			Percent of each nutrient				
Energy	25.22	2.74	2.53	13.67	21.52	22.88	11.44
Protein	22.87	3.18	.89	25.45	47.48	.12	.01
Total fat	1.28	.23	.18	14.36	33.33	50.63	0
Saturated fat	.65	.11	.11	27.28	35.22	36.64	0
Cholesterol	0	0	0	20.35	74.90	4.75	0
Dietary fiber	51.42	30.73	15.76	0	2.09	0	0
Calcium	3.60	5.01	1.57	84.08	5.15	.38	.21
Iron	62.42	9.15	1.66	3.12	23.05	.06	.54
Vitamin A	0	36.89	1.31	31.32	13.53	16.94	0
Vitamin C	0	45.82	46.51	5.76	1.89	.02	0
Folate	26.95	21.56	16.97	14.70	19.69	.13	.01
Vitamin E	.95	3.63	1.86	2.74	7.71	83.11	0

Note: Food groups are grains (wheat flour and rice), vegetables (fresh and processed vegetables, including potatoes), fruits (fresh and processed fruits), dairy (milk, cheese, and frozen dairy products), meats (meat, poultry, fish, eggs, dry beans, and nuts), fats (fats and oils), and sweeteners (sugars and corn sweeteners).

Table 2
Nutrient Availability Changes in Response to a 10-Percent Decrease in Food Prices or a 1-Percent Increase in Income

Nutrient	10-percent decrease in price							1-percent increase in income
	Grains	Vegetables	Fruits	Dairy	Meats	Fats	Sweeteners	
	Percent change							
Energy	0.22	0.18	0.50	0.16	0.52	0.34	0.25	0.26
Protein	.25	.01	.35	.69	1.82	-.04	.21	.27
Total fat	.24	.30	.53	.03	.34	.70	.28	.37
Saturated fat	.27	.20	.50	.55	.88	.71	.23	.38
Cholesterol	.40	-.13	.24	.20	1.46	.17	-.08	.31
Dietary fiber	.13	.59	1.10	-.38	1.31	.13	.20	.21
Calcium	.08	-.03	.86	2.60	.95	-.02	.47	.32
Iron	.33	.27	.33	-.24	1.89	-.02	.24	.21
Vitamin A	1.10	-.65	.66	-2.32	-.26	.30	.63	.35
Vitamin C	-.59	1.49	4.57	-.13	2.31	-.39	-.04	.35
Folate	.07	.44	1.44	-.11	1.42	-.24	.14	.26
Vitamin E	.22	.71	.94	-.56	-1.47	1.12	.47	.38

Note: Food groups are grains (wheat flour and rice), vegetables (fresh and processed vegetables, including potatoes), fruits (fresh and processed fruits), dairy (milk, cheese, and frozen dairy products), meats (meat, poultry, fish, eggs, dry beans, and nuts), fats (fats and oils), and sweeteners (sugars and corn sweeteners).

change at the same rate as the group price. For example, a 10-percent decrease in the price of the meat group would mean that the prices of beef, poultry, fish, eggs, dry beans, and nuts all decrease by 10 percent.

A 10-percent decrease in the price of the meat group would increase daily per capita availability of protein by 1.82 percent, saturated fat by 0.88 percent, cholesterol by 1.46 percent, and iron by 1.89 percent, as consumers buy greater quantities from the meat group. A change in meat prices affects the consumption of meats as well as other foods through the cross-commodity effects of how people adjust their purchases of other foods in response. For example, although meats contribute little to the total availability of fiber, calcium, or vitamin C, a 10-percent reduction in the price of meats also increases overall daily per capita availability of fiber by 1.31 percent, calcium by 0.95 percent, and vitamin C by 2.31 percent. On the other hand, it reduces the overall availability of vitamins A and E.

Increasing consumers' incomes raises consumption of all nutrients, as consumers generally buy more foods. But the levels of all nutrients do not increase equally. A 1-percent increase in income would have the greatest effects on fat, saturated fats, and vitamins A, C, and E (table 2). Intakes of nutrients consumed by Americans in insufficient amounts—calcium, iron, and various vitamins—improve slightly with increased incomes. However, consumption of nutrients overconsumed by Americans—energy, saturated fats, and cholesterol—would also rise slightly with increased incomes. Therefore, the net nutritional effect of increasing consumer income is mixed.

These percentage changes of nutrients (table 2) become even more pronounced once translated into quantity changes per person, per day (table 3). A 10-percent decrease in the price of the meat group increases daily per capita availability of energy by 15.61 calories, total fat by 0.52 gram, saturated fat by 0.44 gram, cholesterol by 5.75 milligrams, calcium by 8.89 milligrams, iron by 0.27 milligram, vitamin C by 1.58 milligrams, and folate by 2.65 micrograms. This same price decrease also reduces daily per capita availability of vitamin A by 2.24 retinol equivalents and of vitamin E by 0.23 alpha-tocopherol equivalent. A 10-percent decrease in dairy prices increases the daily availability of calcium by 24.39 milligrams, and the same price decrease in the fats group increases the daily availability of total fats by 1.08 grams.

A 1-percent increase in income would cause daily per capita nutrient increases, including: energy, 7.82 calories; protein, 0.24 gram; satu-

Table 3
Changes in Nutrient Availability Due to a 10-Percent Decrease in Food Prices or a 1-Percent Increase in Income Even More Pronounced Once Translated into Quantity Changes per Person per Day

Nutrient	Recommended-amount	10-percent decrease in price							1-percent increase in income
		Grains	Vegetables	Fruits	Dairy	Meats	Fats	Sweeteners	
	DV[1]	*Daily per capita change in quantity*[2]							
Energy	2,000	6.65	5.37	14.95	4.87	15.61	10.19	7.59	7.82
Protein	50	.23	.01	.32	.63	1.66	-.03	.19	.24
Total fat	65	.37	.46	.80	.05	.52	1.08	.42	.57
Saturated fat	20	.13	.10	.25	.28	.44	.36	.12	.19
Cholesterol	300	1.57	-.52	.94	.80	5.75	.68	-.32	1.24
Dietary fiber	25	.01	.06	.11	-.04	.14	.01	.02	.02
Calcium	1,000	.75	-.26	8.09	24.39	8.89	-.21	4.39	2.97
Iron	18	.05	.04	.05	-.03	.27	-.00	.03	.03
Vitamin A	1,500	9.52	-5.62	5.67	-20.07	-2.24	2.60	5.43	3.06
Vitamin C	60	-.40	1.01	3.11	-.09	1.58	-.26	-.03	.24
Folate	400	.13	.83	2.69	-.20	2.65	-.44	.26	.49
Vitamin E	20	.03	.11	.15	-.09	-.23	.18	.08	.06

Notes: Food groups are grains (wheat flour and rice), vegetables (fresh and processed vegetables, including potatoes), fruits (fresh and processed fruits), dairy (milk, cheese, and frozen dairy products), meats (meat, poultry, fish, eggs, dry beans, and nuts), fats (fats and oils), and sweeteners (sugars and corn sweeteners). [1]Daily Value (DV) established by the U.S. Food and Drug Administration for nutrition labeling purposes, based on 2,000 calories a day, for adults and children over age 4. Source: Paula Kurtzweil, "Daily Values Encourage Healthy Diet," FDA Consumer (Focus on Food Labeling, An FDA Consumer Special Report), May 1993, pp. 40-43. [2]Daily per capita quantity changes are in calories for energy; grams for protein, fats, and fiber; milligrams for cholesterol, calcium, iron, and vitamin C; micrograms for folate; retinol equivalents (RE) for vitamin A; and alpha-tocopherol equivalent (ATE) for vitamin E.

rated fat, 0.19 gram; cholesterol, 1.24 milligrams; calcium, 2.97 milligrams; iron, 0.03 milligram; vitamin A, 3.06 retinol equivalents; and vitamin C, 0.24 milligram.

Changes in the levels of nutrient quantities in response to changes in prices and incomes are relatively small when compared to the recommended Daily Values (DV) used by the U.S. Food and Drug Administration for nutrition labeling purposes. However, the changes could exacerbate existing nutritional problems if carried over prolonged periods of time.

The effect of an income or price change on overall dietary quality is complex. For example, whereas a lower price for the meat group increases the levels of calcium and iron (a nutritional improvement, given that these components are currently consumed in insufficient amounts), the lower price also increases fat and cholesterol levels (a dietary deterioration, given that these components are consumed in excessive amounts). Similarly, higher consumer incomes increase nutrients consumed in low amounts, as well as nutrients already being consumed in excessive amounts.

Nutrient Response Estimates Useful, But Have Limitations

The estimated price and income effects on nutrients provide information to help policymakers understand how changes in food policies or programs may affect the amount of different nutrients available for consumption and the overall nutritional quality of the diet. For example, proponents of using economic incentives to influence consumption of particular foods or nutrients, such as subsidizing fruit and vegetable prices to increase sales and consumption, should be aware of the interdependent nature of food choices and the ramifications for different nutrients. As another example, the estimated effects of income changes on nutrients can be a starting point in evaluating possible dietary effects when food stamp recipients' benefits are increased or cut. It should be noted, however, that the estimates in this study rep-

resent average nutrient changes. Adjustments might be needed to reflect how food purchases differ among population groups and between food spending using food stamps versus cash.

In addition, these nutrient responses were estimated at the aggregate level, based on foods in their raw commodity forms, and may not reflect the nutrient changes that occur at the consumer level. The food disappearance data commonly used by demand analysts do not account for food preparation methods, which can heavily influence the final nutrient content of foods. For example, whether the chicken is fried or roasted and whether the skin is eaten considerably affect the final nutritional characteristics of the chicken consumed.

Also, the food disappearance data are slow to incorporate changes in the nutrient composition of the commodities themselves, such as occurs from production of leaner meats and lowfat cheeses. Thus, the nutrient contribution of each food group underlying the study's estimates need to be revised over time. Further collaborative research between economists and nutritionists is needed to improve the data on prices, quantities, and nutritional profiles for final food products and make the demand model more reflective of nutrient changes at the consumer level.

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Matching Perception and Reality in Our Diets

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Nutrition advice is often given in terms of eating less of one dietary component (nutrient) or more of another. This advice rests on the assumption that people know not only what nutrients are in the food they eat, but also their quantities—especially difficult information to obtain when dining out at the local cafeteria or steakhouse. Also, nutrition is but one of many attributes people consider in their food choices. Qualities such as taste, variety, and convenience may take precedence over nutrition in people's food consumption decisions.

All the dietary guidance in the world will fall on deaf ears if people believe their diets are already meeting dietary recommendations. Nutrition educators as well as the public would be one step ahead if we can link people's accuracy in assessing their intake to their stock of nutrition knowledge, sociodemographic characteristics, and, of course, actual intake. An added plus is that people's accuracy in assessing their intakes should serve as an indicator of how successfully existing nutrition guidance is being used and understood.

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Realists, Optimists, Pessimists, and the Practical

We used USDA's 1989-91 Continuing Survey of Food Intakes by Individuals (CSFII) and its companion Diet and Health Knowledge Survey (DHKS) to understand how perceived intakes vary from actual consumption, and for which population groups the deviation is largest. Only "meal planners/preparers" are included in both the CSFII and DHKS, so our analysis includes only these individuals. These nationally representative surveys collect information on the foods that people eat and their sociodemographic characteristics, and ask questions about an individual's nutrition knowledge, attitudes about healthy eating, and awareness of the link between diet and health.

To compare people's perceived intake to their actual intake, we focused on a dietary component that has received widespread attention: dietary fat. *The Dietary Guidelines for Americans* recommend that fat constitute 30 percent or less of daily calories. Three-fourths of the respondents in our CSFII-DHKS sample had actual fat intakes that exceeded this limit, averaging 37 percent of daily calories. (A respondent's actual fat intake is the average daily amount of fat from all foods that person consumed over 3 consecutive days.)

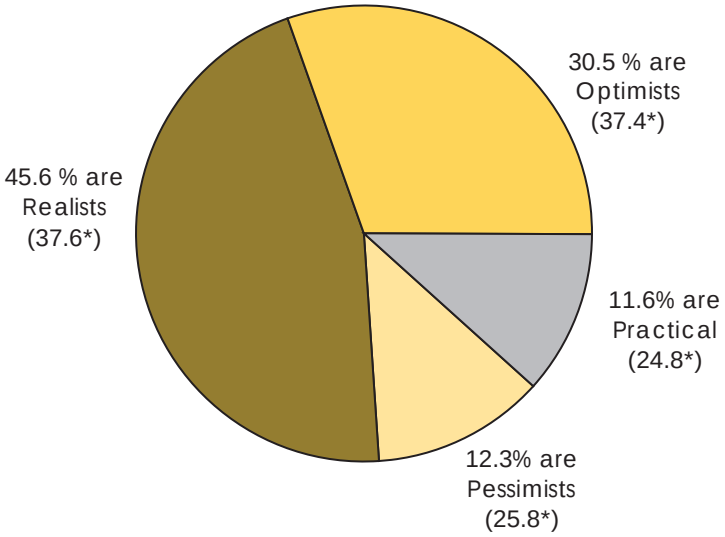
Self-perceived intake is inferred from responses to the DHKS question:

> "Let's talk about your own diet. In your opinion, should your diet be lower or higher (in the amount of) fat or is it just about right compared with what is most healthful?"

A "lower" response implies that the person perceives his or her intake to be above the healthful level, and an "about right" response implies that the meal planner perceives his or her intake to be at or below the healthful level. We eliminated a small number of respondents (about 3 percent) who chose "higher," and based our analysis on the remaining 3,732 observations.

For comparing self-perceived intake to actual intake, we established four categories of accuracy for respondents' assessments. Those who correctly assessed their high actual intakes as "should be lower" were the *Realists*, while those who correctly assessed acceptable levels of their actual intake as "about right" were the *Practical*. Respondents who assessed their high actual intakes as "about right" were the

Figure 1
30 Percent of Respondents Are Optimists Who Mistakenly Assess Their Fat Intake To Be "About Right"



Note: *Mean fat intake as a percent of daily calories.

Optimists, while those who assessed acceptable levels of their actual intake as "should be lower" were our *Pessimists*.

Of the 76 percent of the respondents with excessive fat intakes, approximately 46 percent were *Realists* and the remaining 30 percent were *Optimists* (fig. 1). In both groups, the mean fat intake represented over 37 percent of daily calories. Meanwhile, the 24 percent of respondents whose fat intakes were at or below the recommended level were split fairly evenly between the *Practical*, those who correctly assessed their intake as "about right," and the *Pessimists*, those who believed their intakes should be lower still. The mean fat intakes for these two groups were 25 percent and 26 percent of daily calories, respectively.

Some Quick Policy Implications

These results immediately highlight the potential challenges facing successful nutrition-guidance polices. From a nutrition-guidance perspective, people who have high intakes but who believe their intakes to be "about right"—our *Optimists*—present a special area of concern. People who mistakenly assess their high intakes of fat as "about right" are unaware that their current nutritional choices may be detrimental to their health, and there is no reason to expect them to change their eating habits without further intervention. This group could benefit from additional nutritional education, especially if they are somehow alerted to the health consequences and the fact that they are presently acting under false impressions.

People who have high intakes and correctly assess their intakes as "should be lower"—our *Realists*—raise questions about what would motivate them to change their eating habits. Many considerations—not just the nutritional value of food—affect dietary choices, and this group might be more responsive to nutritional assistance that alters their perception of what "healthy eating" entails by addressing their concerns about the convenience, affordability, and flavor of healthier diets.

From a practical standpoint, persuading the *Realists* to change their dietary habits could prove to be a costly proposition. This group is already aware that their fat intakes exceed healthful levels, but are perhaps reluctant to do anything about it. Alternatively, the *Optimists* may be willing to eat more healthfully if they are made to realize their dietary errors, and they might be more receptive to nutritional advice. Targeting information efforts toward the *Optimists* might offer a higher return from an investment of limited nutrition-education resources.

Assessments Vary Across the Population

Further analysis revealed that respondents who are aware that their fat intakes are too high are also the ones least likely to rate nutrition and avoiding too much fat as "very important" in making their food choices. This may indicate resistance by the *Realists* to current nutrition-guidance strategies. The *Practical* have the highest level of awareness of health problems related to fat; they also rate nutrition and avoiding too much fat as more important than did other groups (fig. 2).

There was little difference in the way the men and women in the

DHKS perceived their fat intakes. Seventy-seven percent of men had intakes above the recommended level, and 41 percent of them were mistakenly optimistic, assessing their fat intakes to be about right (fig. 3). Seventy-six percent of women had fat intakes above the recommended level, and 40 percent of them were *Optimists*.

Although there was little difference between the percentages of Blacks and Whites with high fat intakes, there was a large difference between the two groups in the accuracy of their assessments (fig. 3). More Blacks (65 percent) than Whites (59 percent) correctly assessed their fat intakes as high. Conversely, more Whites (41 percent) incorrectly assessed their high intakes as "about right" than did Blacks (35 percent). Not only did a lower percentage of Hispanics have excessive fat intakes, but the share of Hispanics who correctly assessed their own fat intakes as "should be lower" was greater than that of non-Hispanics (roughly a 2-percent difference).

Seventy-nine percent of people who smoke had fat intakes above the recommended level, compared with 75 percent of nonsmokers (fig. 3). Interestingly, even given their higher fat intakes, smokers appeared to be more aware than nonsmokers of their adverse nutritional status. A lower percentage of smokers (37 percent) mistakenly assessed their high intakes of fat as "about right" than did nonsmokers (41 percent).

The most striking pattern of variation in the accuracy of fat intake assessment occurred with age (fig. 4). Excessive fat intake tended to decline with age. Fat intakes were highest for people between ages 30 and 49 years, and lower for people over 50. However, among respondents with high fat intake, the accuracy of assessment decreased dramatically with age. A progressively higher percentage of older respondents incorrectly assessed their high fat intakes as "about right." While only 32 percent of those under age 30 with high intake were *Optimists*, nearly 60 percent of those over age 70 with high intake were *Optimists*.

Figure 2
Realists Are Least Likely To Rate Avoiding Too Much Fat as "Very Important"

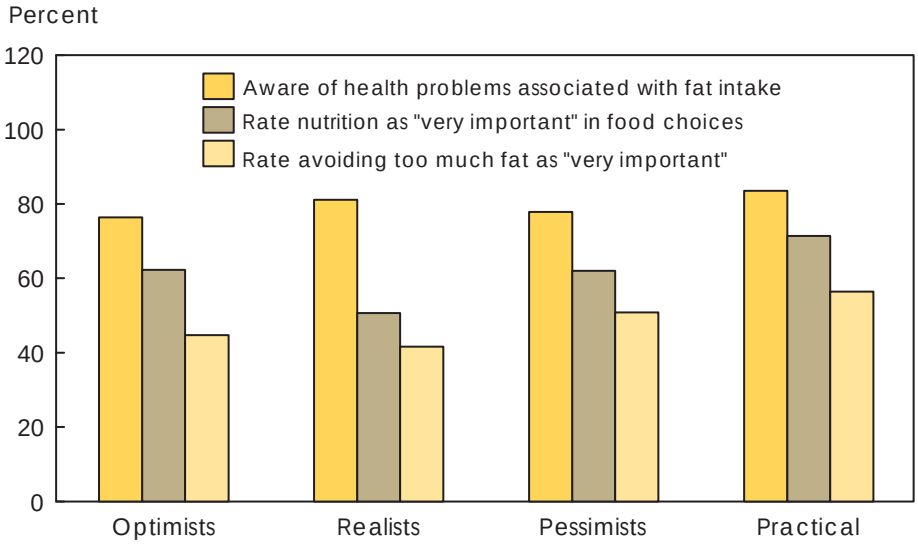
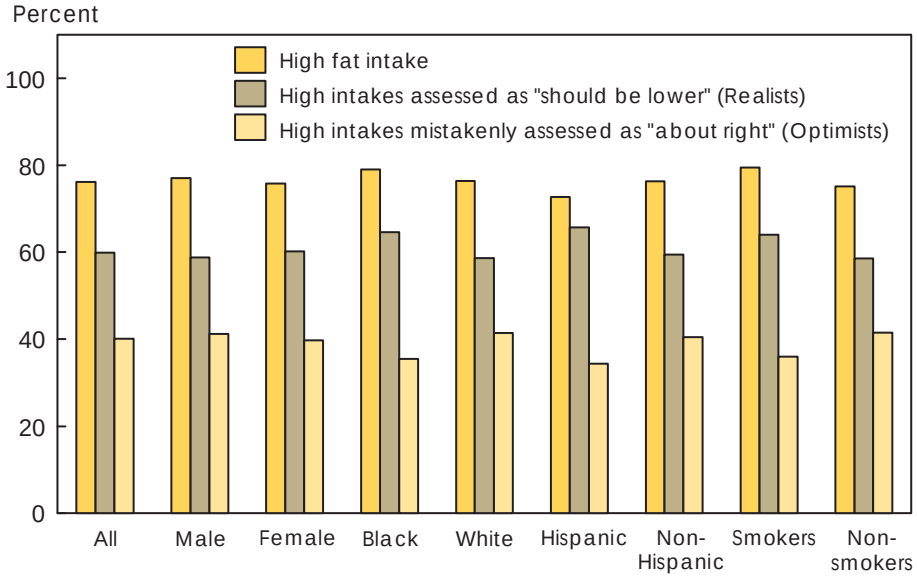


Figure 3
Blacks Are More Realistic Than Whites About Their Fat Intake



This is worrisome, since the risk of chronic health conditions linked to excess fat intake increases with age.

Not surprisingly, accuracy of fat assessment increases with education and income (figs. 5 and 6). More educated and higher income respondents have greater access to magazines and newspapers and, therefore, may have more nutrition information that enables them to assess their intake levels more accurately and make more healthful food choices.

Among those with high fat intake, the share who rated their intake as "about right" decreased as education increased, declining from 45 percent of those with less than a high school education to only 37 percent of those with postgraduate schooling. Similarly, while 47 percent of the poor (those with income at or below 130 percent of the poverty line) rated their high intake as "about right," only 39 percent of wealthier people (those with incomes above 350 percent of the poverty line) did so.

Figure 4
Accuracy of Assessment Is Inversely Related to Age

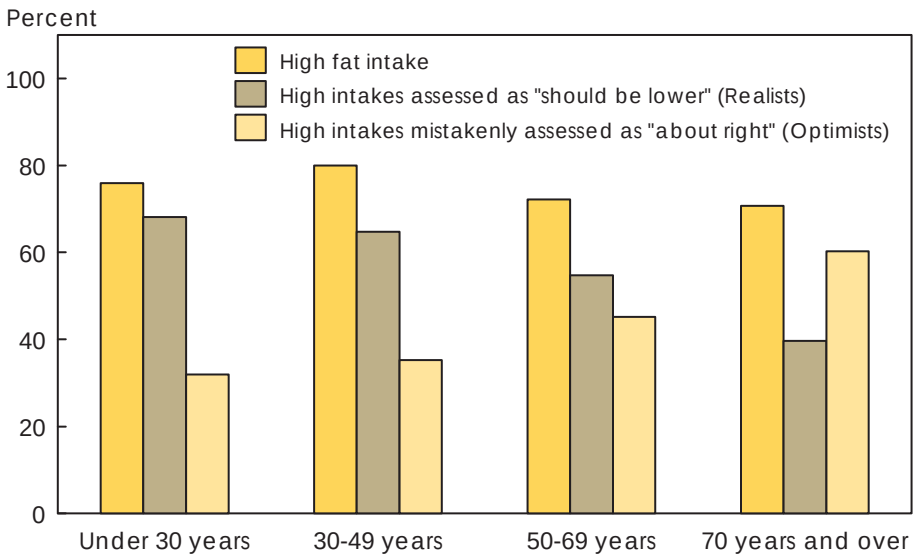
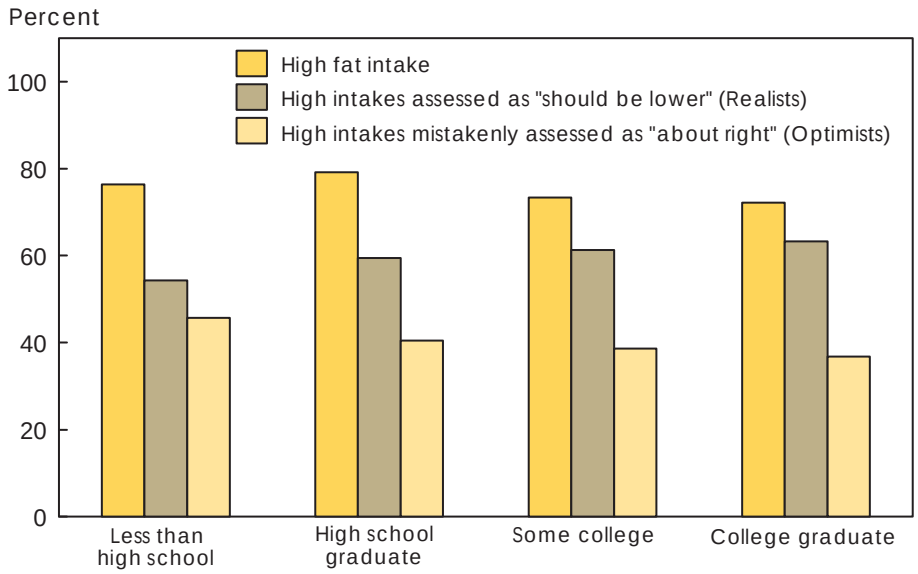


Figure 5
Accuracy of Assessment Increases with Education...

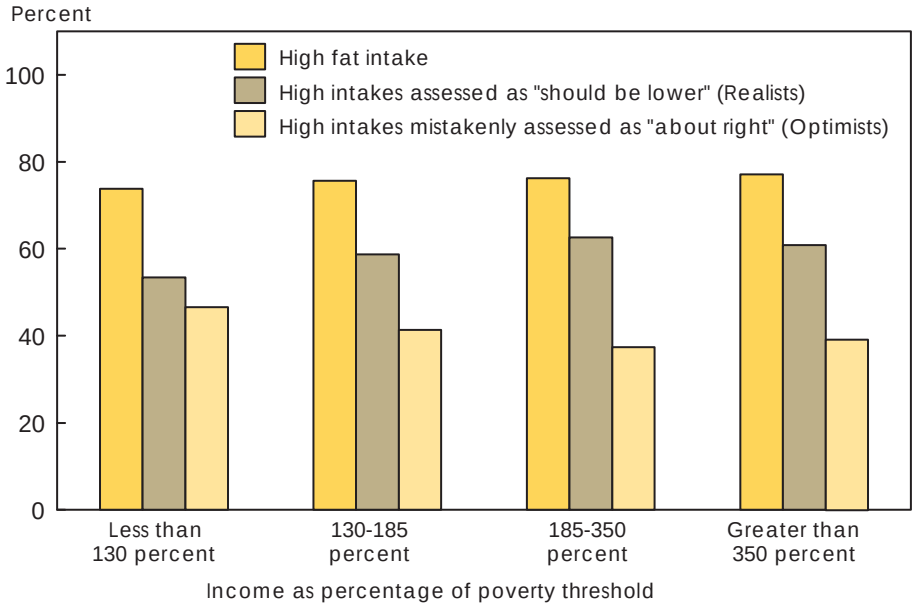


Good Intentions, But Small Changes

While it is difficult to make strong assertions without more rigorous analysis, there is reason to suspect that the groups of respondents who mistakenly assessed their excessive intakes as "about right"—the *Optimists*—may consist largely of people who have intentions of maintaining a healthy diet, but may have misinterpreted or misunderstood the health and diet information available to them. Confusion on the part of consumers in sorting out huge volumes of often-conflicting nutritional and health information has been well documented in both the popular press and in professional literature.

The groups who correctly assessed their intakes as too high—the *Realists*—may be influenced by other elements of nutritional choice. Many of these respondents may be skeptical about the evidence linking health and nutrition. Or they may have strong preferences for high-fat or high-cholesterol foods, coupled

Figure 6
...And Household Income



with doubts about whether a healthier diet could provide the same amount of satisfaction. *Realists* may also find their food choices limited by their income, the time they have available to prepare food, or both.

Dietary habits and perceptions are slow to change, but the recent introduction of food labeling and advertising rules and regulations are a step in the right direction toward helping consumers make smart food choices. The "Nutrition Facts" label, which became mandatory in 1994, lists the content of calories, fat, saturated fat, and cholesterol (in addition to other nutrients) in each serving of most packaged food items. There also have been changes in meat and poultry labeling, and in the health claims that are permitted in food advertising.

Although some consumers have expressed confusion (and sometimes skepticism) about certain aspects of the Nutrition Facts label, studies indicate that the overall effect has been to enhance consumers' ability to make informed nutritional decisions. Various surveys indicate that as many as 78 percent of consumers were well aware of the Nutrition Facts label by 1995. New products that meet U.S. Food and Drug Administration labeling requirements to be called "low fat," "reduced fat," or "light" are being introduced to the market at a rapid pace. This trend may help to make maintaining a healthy diet more convenient and affordable. Also, increased availability of healthier versions of familiar foods could persuade consumers that a healthy diet may not entail as much sacrifice as they had supposed. Perhaps when new food intake surveys are analyzed, the pace of dietary changes will have accelerated.

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Unlocking the Mystery Between Nutrition Knowledge and Diet Quality

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No two people eat exactly alike, but what accounts for the vast differences in diet quality? Diet quality depends on the foods eaten, how they are stored and prepared, and other factors, such as quantities and proportions that influence the nutrient content of meals. Some people's diets are rich in fruits and vegetables, while others are high in grains, meats, or dairy products, and still others consume primarily fried foods. Some dine out frequently, while others produce and prepare their own food. This article examines the role that nutrition knowledge plays in shaping people's diets.

In general, four categories of factors influence food consumption: consumers' incomes, food prices and the prices of other products and services, consumers' knowledge of health and nutrition, and consumers' tastes and preferences. To change consumption, one of these influences must change. For example, nutrition-education efforts attempt to change consumers' knowledge and behavior, while increasing consumer incomes affects tastes and preferences.

It is well-known that personal and household characteristics—such as education, race, ethnicity, and family size—are associated with certain patterns of food consumption. For example, some population groups are more lactose-intolerant than others, and thus consume fewer dairy products. Larger households, usually younger and containing children, consume more soft drinks per person than do older, smaller families. However, personal and household characteristics not only reflect the underlying tastes and preferences of people but also may have an informational or knowledge effect. The most common example cited is that more-educated individuals may acquire, process, and retain information more easily and thus have a higher stock of nutrition knowledge, which is then reflected in the choice of certain foods.

The problem for analysts has been the lack of a unified data set that simultaneously collects measures of nutrition knowledge, demographic information, and food consumption data. Without such information, researchers cannot separate the effect of nutrition knowledge (which is highly correlated with some socioeconomic characteristics) on consumption from the effect of taste and preferences (which cannot be measured directly but must be inferred from personal and household characteristics). Consequently, the influence of demographic factors on food consumption may reflect a combination of an informational effect and a taste effect. Some attributes (such as education) may have an informational effect, some others (such as age) may have a predominantly taste effect, and still others (such as race and ethnicity) may have both effects. Moreover, the two effects may reinforce each other, or work in opposing ways.

Starting in 1985, USDA initiated the Continuing Survey of Food Intakes by Individuals (CSFII). In 1989, the CSFII companion survey, the Diet and Health Knowledge Survey (DHKS) was added. This component provided measures of respondents' health and nutrition knowledge along with their sociodemographic characteristics. These were the first nationally representative surveys to measure both food intake and nutrition knowledge of the same individuals. Using data from the CSFII, USDA has constructed an instrument called the Healthy Eating Index (HEI) to mea-

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sure the overall quality of an individual's diet. Developed by USDA's Center for Nutrition Policy and Promotion, the HEI measures how well a diet conforms to the recommendations of the *Dietary Guidelines for Americans* and the Food Guide Pyramid (see box on measuring diet quality). Introduced in 1995, the HEI provides an important new tool for assessing the quality of Americans' diets and also provides a better understanding of the impact of food choices on their health. It made available for the first time a single summary measure to monitor changes in food consumption patterns. It serves as a report card on the American diet, allowing researchers to analyze how Americans eat, and aids USDA in more effectively promoting proper nutrition. Preliminary analysis indicated that the diets of most Americans need improvement, and some are more likely than others to consume a poor diet.

A major problem faced by nutrition educators and public-health professionals in their efforts to achieve further dietary improvements is a lack of specifics on consumers' use of diet-health information. For example, to what degree does nutrition information access and use vary across different segments of the population? Likewise, does more nutrition information help people to improve their diet quality? Any understanding of factors slowing the adoption of healthful diets requires empirical knowledge of how diet-health information and its effect on dietary choices vary across the population. Such knowledge can be useful for targeting nutrition-education programs, for promoting and marketing foods, and for forecasting food consumption trends.

Our objective was to separate the influence of taste and preferences from the effects of nutrition knowledge on a person's HEI through econometric models. We make a strong case that information and knowledge are keys that will help unlock the door to better diets and in turn better health, longer lives, and children with improved cognitive and learning abilities.

Measuring Diet Quality: The Healthy Eating Index

The HEI measures overall diet quality by evaluating how an individual's diet stacks up to the 10 dietary recommendations in the *Dietary Guidelines for Americans* and the Food Guide Pyramid.

The first five HEI components measure the extent to which a person's diet conforms to the Food Guide Pyramid serving recommendations for the grain, vegetable, fruit, milk, and meat groups. For each of these five food-group components of the HEI, an individual's diet is assigned a score between 0 and 10. Those consuming the recommended number of servings received a maximum score of 10 (a score of zero was assigned for any food group where no items from that food group were eaten). Intermediate scores were given for intakes between the two limits, calculated proportionately to the number of servings consumed. For example, if the recommended number of servings for the grain group was eight and an individual consumed four servings of grain products, then the person would receive a score of 5 points (half of 10) for the grain component of his or her HEI.

HEI components 6-10 measure the extent to which a person's diet conforms to the Dietary Guidelines recommendations for total fat, saturated fat, cholesterol, sodium, and variety. An individual's diet was assigned a score between 0 and 10 for these components as well. The scores for fat and saturated fat were related to their consumption in proportion to total food energy (calories). Fat intakes less than or equal to 30 percent of total calories were given a score of 10. The score declines to zero when the proportion of fat to total calories was 45 percent or more. Intakes between 30 and 45 percent were scored proportionately. Saturated fat intake of less than 10 percent of total calories received a score of 10, while zero points were given for saturated fat intake of 15 percent or more of calories. Scores were proportionately given for fat intake between 10 and 15 percent of total calories.

Scores for cholesterol and sodium were given based on milligrams consumed in the diet. A score of 10 was given for cholesterol intake less than or equal to 300 milligrams daily. Zero points were given for intake at or over 450 milligrams. For sodium, the maximum score meant intake was less than or equal to 2,400 milligrams. A zero score was given for sodium intake at 4,800 milligrams or higher.

Dietary variety was assessed by totaling the number of "different" foods eaten in amounts sufficient to contribute at least half of a serving in one or more of the five pyramid food groups. Food mixtures were broken into their component ingredients and assigned to relevant food groups. Similar foods, such as two different forms of potatoes or two different forms of white bread, were grouped together and counted only once in measuring the score for variety. A maximum score of 10 was awarded if 16 or more different food items were consumed over a 3-day period. A score of zero was given if six or fewer distinct food items were consumed.

Complete details on the construction of HEI can be found in the USDA's Center for Nutrition Policy and Promotion publication *The Healthy Eating Index*, CNPP-1, Oct. 1995.

Variations in Diet Quality: A First Look...

Consumers' sociodemographic background affects their food choices in two ways—nutrition information and taste / preferences. Sociodemographic background may influence consumers' nutrition knowledge, which, in turn, affects their food choices. Sociodemographic background also shapes tastes and preferences, which also influence food choices.

For instance, people with higher levels of education may acquire more information about the health effects of foods and this may induce them to improve the quality of their diets by, for example, consuming more fruits and vegetables. Similarly, women may be more aware of diet-health relationships than men, and this increased awareness may be translated to better quality diets. Conversely, food choices may be influenced by a person's ethnicity, which reflects tastes acquired through tradition. For example, Hispanics may choose a different type of diet than others due to traditional eating habits. Or, a person's food tastes may change with age due to physiological changes. These knowledge and taste effects may reinforce each other, or work in opposing ways.

A Closer Look: Nutrition Knowledge

The following descriptive analysis of average HEI and nutrition knowledge scores for different population groups should be interpreted cautiously, since some characteristics are correlated. For example, higher HEI scores that are associated with higher education levels may be partially caused by higher income, since education levels tend to influence income levels.

We used responses to two sets of questions in the DHKS to develop measures of nutrition knowledge. The first measure represents the respondents' knowledge of the nutrient content of foods. The second measure reflects awareness of the health effects of various dietary choices.

Nutrient Content

Respondents were asked to choose the correct answer from each of a series of questions about sources and occurrence of various food components and nutrients in common food items. Our measure of nutrient-content knowledge represents the number of correct answers given by a respondent to 21 of these questions. Respondents

Table 1
Most People Can Identify Which Foods Have More Fat, Fiber, and Cholesterol

Question	Respondents answered— Correctly	Incorrectly
	Percent	
Which has more fiber?		
Fruits or meats	77.7	22.3
Cornflakes or oatmeal	79.5	20.5
Whole-wheat bread or white bread	91.8	8.2
Orange juice or an apple	74.0	26.0
Kidney beans or lettuce	56.3	43.7
Popcorn or pretzels	73.6	26.4
Which has more cholesterol?		
Liver or T-bone steak	52.3	47.7
Butter or margarine	87.2	12.8
Egg whites or yolks	84.6	15.4
Skim milk or whole milk	95.0	5.0
Which has more fat?		
Regular hamburger or ground round	87.8	12.2
Loin pork chops or pork spare ribs	72.0	28.0
Hot dogs or ham	61.3	38.7
Peanuts or popcorn	90.5	9.5
Yogurt or sour cream	85.9	14.1
Porterhouse steak or round steak	58.8	41.2
Ice cream or sherbet	95.0	5.0
Roast chicken leg or fried chicken leg	94.6	5.4
Which kind of fat (saturated or polyunsaturated) is more likely to be a liquid rather than a solid? Or, are they equally likely to be liquids?	29.6	70.4
Is cholesterol found in vegetables and vegetable oils, animal products, or all foods containing fat or oil?	38.7	61.3
If a food is labeled cholesterol-free, is it also low in saturated fat, high in saturated fat, or either?	55.6	44.4

Note: Correct answers are underscored here. Source: 1989-90 Diet Health Knowledge Survey, USDA.

answered an average of 15 questions correctly (table 1).

These questions probed knowledge of the fiber, cholesterol, and fat content of foods. For example, respondents were asked to identify which of two foods has the higher fiber content: fruits or meat, cornflakes or oatmeal, popcorn or pretzels. They were also asked to identify which foods contain more cholesterol: liver or T-bone steak, butter or margarine, skim or whole milk. Other questions probed knowledge about different kinds of fat, the types of foods that contain cholesterol, and the relationship between fat and cholesterol.

Respondents identified the correct answer to some of the comparisons more easily than others. For example, over 90 percent correctly identified whole-wheat bread as containing more fiber than white bread, but only 56 percent knew that kidney beans contained more fiber than lettuce (table 1). Likewise, virtually everyone (95 percent) knew that skim milk has less cholesterol than whole milk, but only 52 percent correctly identified liver as containing more cholesterol than a T-bone steak. The same held true for the questions concerning fat content. Most knew that ice cream contained more fat than sherbet, and that fried chicken was higher in fat than roasted chicken, but far fewer knew that a porterhouse steak contained more fat than does a round steak. When asked what kind of fat (saturated or polyunsaturated) is more likely to be a liquid rather than a solid, only 30 percent of respondents correctly identified polyunsaturated. Less than 40 percent of the respondents knew that cholesterol is found only in animal products.

Diet and Health

The measure of awareness of diet-health problems is based on answers to eight questions from the DHKS in the general form: Have you heard about any health problems that might be related to how much of a particular nutrient or food component a person eats?

About 85 percent of the respondents indicated that they had heard of health problems associated with salt, but less than 50 percent said the same for fiber and iron (table 2). We constructed the diet-health awareness measure by adding together the positive responses for each of the eight questions. We use positive, not correct, responses because a belief that an association exists between a health problem and food component or nutrient is often all that is required to provide motivation for change.

Comparing Nutrition Knowledge with HEI Scores

USDA rates HEI scores of greater than 80 as "Good," scores of 51-80 as Needs Improvement," and scores below 51 as "Poor." We found that higher HEI scores are clearly associated with increased knowledge about the nutrient content of foods as well as about diet-health awareness (table 3). For example, individuals with Good scores answered an average of two more questions correctly about nutrient content than did people with Poor HEI scores.

Age appears to be strongly associated with higher HEI scores. On average, people over age 69 scored 10 points higher than those under age 30. However, there was no clear association between age and nutrient knowledge or diet-health awareness. On the other hand, women had higher HEI scores than men and higher nutrient knowledge and diet-health awareness levels.

Race and ethnicity appear to influence HEI scores as well as nutrient knowledge and awareness. Whites had higher HEI scores on average than Blacks, but the scores of Hispanics and non-Hispanics were virtually identical. Non-Hispanics' nutrient-content knowledge and diet-health awareness scores were higher than Hispanics'.

Higher education and incomes were correlated with more knowledge of the nutrient content of foods, more awareness of diet-health problems, and to higher HEI scores. Smokers had lower HEI scores than nonsmokers and slightly

Table 2
Majority Are Aware of Health Problems Related to Nutrients, Except Fiber and Iron

Question	Respondents answered—Yes	No
	Percent	
Have you heard about any health problems that might be related to how much...		
Fat a person eats?	71.3	28.7
Saturated fat a person eats?	58.6	41.4
Fiber a person eats?	48.8	51.2
Salt a person eats?	84.7	15.3
Calcium a person eats?	59.3	40.7
Cholesterol a person eats?	81.7	18.3
Sugar a person eats?	79.6	20.4
Iron a person eats?	47.5	52.5

Source: 1989-90 Diet Health Knowledge Survey, USDA.

lower knowledge and awareness scores.

Information Differences and Sociodemographic Characteristics

Nutrient-content knowledge, diet-health awareness, and HEI clearly differ according to an individual's sociodemographic background, but what underlies these differences? Are the differences in diet quality among sociodemographic groups due to differences in health and nutrition knowledge or to differences in tastes and preferences?

We undertook a comprehensive multivariate statistical analysis to separate the influence of these two factors and to determine the effects of knowledge on diet quality. We also examine the impact of a single personal or household characteristic on a person's nutrient-content knowledge level when the other characteristics are held equal.

If we compare two people with similar sociodemographic characteristics (same sex, race, income level, and so forth) except that one had a postgraduate education while the

Table 3
Healthy Eating Index Increases With Age, Education, and Household Income

Respondent profile	Nutrient-content knowledge	Diet-health awareness	Healthy Eating Index (HEI)
	Number of correct answers		*Mean HEI score*
HEI:			
Less than 51	14.41	4.71	44.99
51-80	15.45	5.33	64.79
Greater than 80	16.55	6.04	88.09
Education:			
Less than high school	14.10	4.53	62.57
High school	15.56	5.20	62.97
More than high school	16.56	6.21	66.67
Income per capita:			
$3,800 or less	14.28	4.72	59.52
$3,801-5,400	14.69	4.74	63.47
$5,401-10,200	15.30	5.18	64.52
$10,201 or more	16.57	6.06	66.83
Age:			
Under 30	15.09	4.84	59.28
31-49	15.67	5.64	61.51
50-69	15.68	5.44	67.17
Over 69	14.74	4.84	69.33
Gender:			
Male	14.75	4.95	60.59
Female	15.56	5.39	64.79
Race:			
White	15.74	5.49	64.78
Black	13.76	4.41	59.66
Other	14.12	4.47	63.56
Ethnicity:			
Non-Hispanic	15.55	5.37	64.04
Hispanic	13.56	4.60	64.11
Smoking:			
Smoker	15.04	4.93	58.63
Nonsmoker	15.55	5.45	65.98

Table 4
Nutrition Knowledge Increases Steadily With the Level of Education

Personal characteristic	Additional nutrient-content questions answered correctly
Level of education (compared to those with less than a high-school education):	
High school	.60
Some college	1.13
College	1.74
Postgraduate	2.17
For an additional year of age	0
Female (compared to male)	1.10
Race (compared to Whites):	
Black	-.97
Other race	-1.40
Hispanic (compared to non-Hispanic)	-1.40
Employment status (compared to those employed full time):	
Employed part time	.33
Not employed	0
For an additional unit of body mass index[1]	0
Smoker (compared to nonsmoker)	-.21
For an additional $10,000 in household income	.25

Note: [1]Body mass index is the ratio of a person's weight in kilograms to the square of height in meters.

other did not complete high school, the more educated person generally answers correctly two more nutrient-content questions than does the other person (table 4).

Similarly, all things being equal, women correctly answer one more nutrition-knowledge question than men. On the other hand, other things equal, a person's age or weight relative to height (body mass index) has no influence on nutrition knowledge.

A person's race and ethnicity also play a role in his or her nutrition knowledge. Blacks and people from other non-White racial groups have lower nutrition knowledge than Whites, other things being equal. Hispanics tend to have lower nutrition knowledge than non-Hispanics.

Diet Quality Differences Could Be Due to Information or Taste Differences

Personal and household characteristics help shape people's taste and preferences and nutrition knowledge levels, which in turn help determine diet quality. It is important for the effective design and execution of nutrition-education efforts that we isolate the characteristics that determine nutrition-knowledge levels from those primarily influencing tastes, as well as separate the influence of those that affect both information and tastes.

Assume that John and Bob have identical sociodemographic characteristics, including their knowledge of nutrition, with one exception: John never completed high school but Bob went on to postgraduate studies. Our statistical models would predict that John's HEI is over 6 points higher than Bob's (table 5). At first glance, this is a surprising result. But with a few additional pieces of information, the story falls in place. Recall that in this scenario, we are assuming that despite their different educational levels, John and Bob have the same level of nutrition knowledge. Therefore, the effect of Bob's higher education level on his diet may be associated with his preference for convenience foods, dining out, and more costly food items, such as prime rib. This in turn leads to a lower HEI for Bob than for John.

However, from what we learned from table 4, more highly educated people tend to have more nutrition knowledge than do those with less education. Using Bob and John as examples, let's now assume that since Bob has more education he also has more nutrition knowledge than John. The result is vastly different—Bob's HEI is now 5.5 points higher than John's (table 5). Bob's higher education is associated with higher levels of nutrition information, which more than offsets his preferences for dining out and convenience. The result is a higher HEI score than the less-educated John.

We also find that men and women, if identical in all other sociodemographic and knowledge respects, have virtually the same HEI's. But if we assume that women have more nutrition knowledge, their HEI's are about 5 points higher than for men. A particularly dramatic example occurs for Hispanics. Suppose we have two people, one Hispanic the other not, but otherwise possessing identical sociodemographic characteristics. The Hispanic has an HEI score almost 9

points higher than the non-Hispanic. However, if we allow the levels of nutrition information to be higher for the non-Hispanic, as our research finds, then the Hispanic now has an HEI only about 2 points higher than the non-Hispanic. This result assumes that any differences in answers given by respondents are due to knowledge and not language differences.

Another surprising result occurs when we examine the relationship between income and diet quality. If we take two people with identical characteristics except one has a higher income, the wealthier person has a lower HEI. This is due to higher incomes being associated with preferences for convenience foods, dining out, and more expensive, fat-rich foods, all of which contribute to a lower HEI. However, we know that income is also associated with higher nutrition-knowledge levels. When this is taken into account, higher income people actually have a slightly higher HEI than do their lower income counterparts.

In contrast to income, education, and gender effects, however, the effects of age, body mass, and smoking are almost entirely due to different tastes and preferences associated with these characteristics and not due to any informational differences.

Diet quality tends to improve with age. However, this effect is entirely due to changing tastes, since age has no effect on nutrition information once other sociodemographic effects are taken into account (table 4). Similarly, smokers are nearly as informed about health and nutrition as nonsmokers, yet smokers tend to prefer a less healthful diet and thus tend to have a lower HEI. Diet quality deteriorates for those with higher body mass, even though they are as equally informed about health and nutrition as people with a lower body mass index. Another important characteristic influencing a person's HEI is labor force participation. As the estimates for employment status in tables 4 and 5 show, this influence is largely due to knowledge differences.

Table 5
When Knowledge Is Factored Out, a More Educated Person May Have a Lower HEI Than a Less Educated Person

Personal characteristic	Change in HEI score when two individuals have the same level of knowledge	Change in HEI score when two individuals have different levels of knowledge
Level of education (compared to those with less than a high-school education):		
High school	-2.15	1.13
Some college	-2.31	3.89
College	-4.10	5.22
Postgraduate	-6.17	5.53
For an additional year of age	.18	.19
Female (compared to male)	0	4.99
Race (compared to Whites):		
Black	3.40	-1.61
Other race	6.64	0
Hispanic (compared to non-Hispanic)	8.90	1.89
Employment status (compared to those employed full time):		
Employed part time	0	1.74
Not employed	0	1.19
For an additional unit of body mass index[1]	-.20	-.13
Smoker (compared to nonsmoker)	-3.48	-4.59
For an additional $10,000 in household income[2]	-.61	.64

Note: [1]Body mass index is the ratio of a person's weight in kilograms to the square of height in meters.

A Last Look: Some New Findings

Many regard information and knowledge as the keys that will unlock the door to better diets and in turn better health, longer lives, and children with improved cognitive and learning abilities. We verify some of these observations with the finding that more nutrition knowledge leads to higher HEI scores.

Nutrition information affects overall diet quality, even after controlling for individual differences in a host of personal and household characteristics, including income, education, age, gender, race, ethnicity, smoking behavior, and body mass. The positive effects of higher incomes and education levels on diet quality are due to the greater nutrition knowledge that wealthier, more educated people possess. If this informational advantage were to disappear, for example through nutrition-education targeted to low-income individuals or that starts early in childhood, then those with greater incomes or education may in fact have diets that are no better, or possibly poorer, than would people with lower incomes or education. This is because people with higher incomes or education may have a greater preference for convenience foods and food away from home that are often less nutritious.

The strong link between nutrition knowledge and diet quality suggests a continued role for nutrition-education efforts to close the persistent gap between actual and healthful diets.

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Milk and Milk Products: Their Importance in the American Diet

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Small increases between 1970 and 1994 (the latest year for which nutrient data are available) in per capita availability of dietary calcium and milkfat—up 8 percent and 4 percent, respectively—belie huge shifts in dairy product consumption patterns since 1970. In 1997, Americans, on average, consumed nearly a fourth less beverage milk and two-and-a-half times more cheese than they did in 1970.

A big increase in calcium consumption from cheese more than offset a 21-percent decline in calcium consumption from beverage milks. Similarly, a huge increase in consumption of milkfat from cheese more than offset a 50-percent decline in milkfat consumption associated with declining milk consumption and a pronounced trend toward lower fat milks. Carbonated soft drinks—average consumption of which is now more than double what it was in 1970—are likely displacing beverage milks in the diet. Behind big rises in cheese and soft drink consumption is a big increase in eating away from home, especially at fast-food places, which favor pizza, cheeseburgers, and soft drinks.

The per capita level of calcium in the current U.S. food supply, after accounting for waste in the food marketing system and at home, is insufficient to meet the population-weighted average required to meet 1989 U.S. Recommended Dietary Allowances (RDA's) for calcium. This is a critical public-health problem, especially in light of impending changes in dietary recommendations to increase calcium consumption.

Milk and milk products make important contributions to the American diet. They provide high-quality protein and are good sources of vitamins A, D, and B-12, and also of riboflavin, calcium, phosphorus, magnesium, potassium, and zinc.

Milk and milk products like cheese, yogurt, and frozen dairy desserts are the main source of calcium—contributing about three-quarters of the calcium in the U.S. food supply.

Calcium is important from a public-health perspective, because current calcium intakes by many consumers are not sufficient for them to attain optimal peak bone mass and to prevent age-related loss of bone, leading to osteoporosis. Bone mass peaks around age 30, usually remains stable in the 30's, and commonly begins a decline in the 40's that accelerates around age 50. Recent research also indicates that adequate calcium intake is one key to achieving optimal blood pressure. At particular risk for low calcium intakes are a substantial number of American teenagers, adult women, and the elderly.

In 1997, the Food and Nutrition Board's Institute of Medicine (IOM) issued a report calling for Americans to consume calcium at levels considerably above the 1989 RDA's. The RDA's for calcium intake are 800 milligrams for children ages 1-10 years, men 19 years and above, and women 25 years and above (except those pregnant or lactating); and 1,200 milligrams for males ages 11-18 years and females 11-24 years. The IOM recommends calcium intakes be increased to at least 1,000 milligrams a day (a little more than the amount in three 8-ounce servings of fluid milk) for all Americans over 8 years of age. Even higher calcium intakes are recommended for adults over age 50 (1,200 milligrams per day, or 4 servings), and for teens 9 through 18 years (1,300 milligrams per day, a little over 4 servings). The IOM guidelines include a calcium ceiling of 2,500 milligrams daily to avoid problems associated with

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higher doses, such as kidney stones. The guidelines also boost the recommendation for vitamin D, which is needed for proper calcium absorption, to 400 international units (IU's) for adults between ages 51 and 79, and 600 IU's for those age 80 and over.

The Federal Government identifies low calcium intake as a major nutrition priority. Its dietary guidance encourages most Americans to increase their daily calcium intake, and recommends two to three servings a day from the milk, yogurt, and cheese group. Yet, USDA's food intake survey data indicate that Americans 2 years of age and over consumed an average 1.5 servings a day of dairy foods in 1994-96.

USDA's Economic Research Service (ERS) and Center for Nutrition Policy and Promotion (CNPP) estimate per capita food and nutrient supplies, based on records of commodity flows from production to end uses. These data are used as a proxy to estimate human consumption, even though the data may overstate what is actually eaten because they represent food supplies available in the market and do not account for waste.

Calcium Critical to the Body's Health

Calcium is the most abundant mineral in the human body and it is essential for life. Over 99 percent of total body calcium is found in the teeth and bones. The remainder is present in blood, extracellular fluid, muscle, and other tissues, where it helps regulate the heart beat and blood pressure, sends nerve impulses, helps clot blood, stimulates hormone secretions, and activates enzyme systems.

Bone is a dynamic tissue that is constantly being formed and broken down. This process, called remodeling, is the resorption or breaking down of existing bone and deposition of new bone to replace that which has been broken down. Bone formation exceeds resorption in growing children and teens, is balanced with resorption in healthy adults, and lags behind resorption a little in the 40's and much more

Risk of Osteoporosis Can Be Lowered

Osteoporosis is a painful, sometimes crippling disease in which bones become so fragile they spontaneously break as a result of a minor fall or even from everyday activities, such as bending over to pick up a newspaper. The incidence of osteoporosis has reached epidemic proportions in the United States and is responsible for considerable death, illness, loss of independence, and associated economic costs. More than 28 million Americans, mostly women and mature adults, are affected by osteoporosis. This disease leads to 1.5 million fractures a year (fractures of the spine, hip, and wrist are the most common) and as many as 50,000 deaths a year from physiological stress resulting from hip fractures. USDA's Economic Research Service estimates complications due to hip fractures to cost $13 billion to $18 billion a year in medical charges and lost productivity.

The risk of developing osteoporosis is influenced by both genetic and environmental factors. Genetic factors cannot be controlled, but do impact on bone health, as does gender, race, and age. Women are four to five times more likely to develop osteoporosis than are men. Caucasian women, particularly those of northern European ancestry, and Asian women are at higher risk of developing osteoporosis than are African Americans and other groups. Osteoporosis is most likely to develop in the fourth and fifth decades of life.

On the other hand, lifestyle risk factors can be controlled. These include the inadequate dietary intake of calcium and vitamin D; excessive intake of sodium, protein, caffeine, and fiber; lack of physical exercise and strength training; cigarette smoking; and excessive alcohol intake.

The key to preventing osteoporosis is to maximize the peak bone mass reached by about age 30 and to reduce the rate of bone loss in later years. This is best done with optimal intake of calcium throughout life—from early childhood and adolescence though the postmenopausal and later adult years.

While calcium-rich foods or calcium-fortified foods are the preferred choice, for those who cannot achieve a high calcium intake (1,000 to 1,500 milligrams daily) through diet, supplements are recommended—ideally as calcium citrate or calcium carbonate. Absorption of calcium supplements is the most efficient in doses of 500 milligrams or less, and when taken between meals in the case of calcium citrate and with meals in the case of calcium carbonate.

Lifestyle changes other than dietary ones need to focus on avoiding cigarette smoking and on participating in regular physical activity. Smokers generally have lower bone densities and are more likely to suffer osteoporotic fractures than are nonsmokers. Regular physical activity benefits bone health at all stages of the life cycle. Weight-bearing exercise like walking, running, and weight-lifting in conjunction with adequate calcium intake from foods will reduce the risk of osteoporosis for most people.

after menopause and with aging in both men and women.

Adequate dietary calcium is essential for building denser, stronger bones in the first three decades of life and for slowing the rate of bone loss in later years. Optimal calcium intake varies according to a person's age, sex, and ethnicity, but the accumulation of bone mineral achieved in early life influences the occurrence of osteoporosis, the major underlying cause of bone fractures in postmenopausal women and the elderly (see box on osteoporosis). A calcium-deficient diet before age 30 may limit a person's ability to reach optimal peak bone mass, while one after age 30 fails to slow the rate of bone loss and maintain bone density. Both events increase the risk of osteoporosis later in life. Also, the elderly need to maintain optimal intakes of calcium to minimize the age-related decrease in calcium absorption and the increased risk of osteoporotic fractures with advancing age.

Table 1
Americans Are Drinking Less Milk, Eating More Cheese

Item	*Unit*	1970	1994[1]	1997
Beverage milk[2]	*gallons*	31.3	24.8	24.0
Plain	"	29.6	23.3	22.5
Whole	"	24.8	8.8	8.2
Reduced fat (2%)	"	3.2	8.7	7.7
Lowfat (1% and 0.5%)	"	.2	2.4	2.6
Fat-free (skim)	"	1.3	3.3	4.0
Yogurt[3]	*½ pint*	1.5	8.6	9.5
Fluid cream products	"	9.8	15.2	17.0
Half and half	"	5.4	5.9	6.2
Light cream	"	.7	.6	.8
Heavy cream	"	1.0	2.7	3.6
Sour cream	"	2.0	5.2	5.6
Eggnog	"	.6	.8	.7
Cheese[4]	*pounds*	11.4	26.8	28.0
Cheddar	"	5.8	9.1	9.6
Mozzarella	"	1.2	7.9	8.4
Cream and Neufchatel	"	.6	2.2	2.3
Cottage cheese	"	5.2	2.8	2.7
Lowfat	"	.3	1.2	1.3
Frozen dairy products[5]	"	28.5	29.9	28.7
Ice cream	"	17.8	16.1	16.2
Lowfat ice cream[6]	"	7.7	7.6	7.9
Sherbet	"	1.6	1.4	1.3
Frozen yogurt	"	NA	3.5	2.1
Evaporated and condensed milk	"	12.0	8.1	6.6
Whole	"	7.0	2.6	2.6
Skim	"	5.0	5.5	4.0
Dry milk	"	5.8	4.1	4.0
Dried whey	"	1.4	3.8	3.4
Butter	"	5.4	4.8	4.2
All dairy products, milk-equivalent, milkfat basis	"	563.8	586.0	579.8

Notes: NA = not available. [1]Latest year for which data on the nutrient content of the food supply are available. [2]Includes flavored milk and buttermilk. [3]Excludes frozen yogurt. [4]Excludes full-skim American, cottage, pot, and baker's cheese. [5]Includes mellorine until 1990 and other nonstandardized frozen dairy products not listed separately. [6]Formerly known as ice milk.

Less Milk, More Cheese Slightly Increase Levels of Calcium and Saturated Fat

In 1997, Americans, on average, drank nearly a fourth less milk as in 1970 (table 1). Between 1970 and 1997, annual supplies of beverage milks declined 7 gallons per person, to 24 gallons per person. The trend in beverage milks is toward lower fat drinks, such as reduced-fat, low-fat, and fat-free milks. Plain milk (excluding flavored milk and buttermilk) accounted for 94 percent of total beverage milk in 1997. In 1997, whole milk (about 3.25 percent fat) accounted for 36 percent of all plain beverage milk, reduced-fat milk (2 percent) for 34 percent, and lowfat milks (1 percent and 0.5 percent) and skim milk (less than 0.5 percent) combined for 30 percent. In 1970, the percentages were 84 percent for whole milk, 11 percent for reduced-fat milk, and 5 percent for lowfat milks and skim milk combined. Steady declines in per capita consumption have occurred since 1946 for whole milk and since 1990 for 2-percent milk. Between 1989 and 1997, per capita consumption dropped 25 percent and 16 percent, respectively, for whole milk and 2-percent milk, and increased 53 percent for lowfat milks and skim milk combined.

In 1997, Americans ate nearly two-and-a-half times as much cheese as in 1970. Per capita consumption of cheese shows consistent yearly increases since 1970. Its use increased from 11.4 to 28.0 pounds per person per year between 1970 and 1997.

Per capita levels of calcium in the U.S. food supply rose 8 percent between 1970 and 1994, from 890 milligrams per person per day to 960 milligrams. The increase was due mainly to greater use of cheese.

Table 2
The 1994 Food Supply Could Not Support the Latest Calcium Intake Recommendations

Measure and life-stage group	Suggested amount of calcium per day
Optimal Calcium Intake values[1]	*Milligrams*
Population-weighted average (1994)	1,180
Infants:	
Birth to 6 months	400
6 months to 1 year	600
Children:	
1-5 years	800
6-10 years	800-1,200
Adolescents and young adults:	
11-24 years	1,200-1,500
Men:	
25-65 years	1,000
Over 65 years	1,500
Women:	
25-50 years	1,000
51-65 years (on estrogen)	1,200
51-65 years (not on estrogen)	1,500
Over 65 years	1,500
Pregnant and nursing	1,200-1,500
Dietary Reference Intake (DRI) values for calcium[2]	
Population-weighted average (1994)	1,040
Infants:	
Birth to 6 months	210
6 months to 1 year	270
Children and adolescents:	
1-3 years	500
4-8 years	800
9-18 years	1,300
Adults:	
19-50 years	1,000
Over 50 years	1,200
Pregnant and nursing:	
Under 19 years	1,300
19-50 years	1,000

continued—

In 1994, milk and milk products contributed 73 percent of the calcium available in the food supply, compared with 75 percent in 1970. Mirroring product consumption, calcium contributions from lower fat milks and cheese more than doubled between 1970 and 1994, but dropped two thirds for whole milk (fig. 1). Other contributors to total calcium in the 1994 food supply were vegetables and legumes (10 percent), grains (5 percent), and other sources (12 percent). While grains are not particularly rich in calcium, they are often consumed in large quantities and thus can account for a substantial proportion of dietary calcium.

Table 2
The 1994 Food Supply Could Not Support the Latest Calcium Intake Recommendations—*continued*

Measure and life-stage group	Suggested amount of calcium per day
Recommended Dietary Allowances (RDA) for calcium[3]	*Milligrams*
Population-weighted average (1994)	870
Infants and children:	
Birth to 6 months	360
6 months to 1 year	540
1-10 years	800
Males:	
11-18 years	1,200
Over 18 years	800
Females:	
11-24 years	1,200
Over 24 years	800
Pregnant and nursing	1,200
1994 U.S. per capita food supply[4]	
All ages, total food supply	960
All ages, net food supply (exluding estimated losses from food spoilage and waste)	680

Notes: [1]National Institutes of Health, 1994. [2]Institute of Medicine, Food and Nutrition Board, 1997. [3]National Research Council, 1989. [4]The 1994 food supply provided 960 milligrams of calcium per person per day. Of that 960 milligrams, ERS estimates that 280 were lost to milk spill, plate waste, and spoilage. The net/residual amount (total minus spoilage and waste) would put dietary intake of calcium in 1994 at about 680 milligrams per person per day, well below the 1994 population-weighted averages that would have been required to meet the Optimal Calcium Intake values, the Dietary Reference Intake values, or the 1989 RDA's.

Milk and milk products are good sources of a number of other nutrients in the food supply, providing about one-third of the total supply of riboflavin and phosphorus in 1994; about one-fifth of the total supply of protein, vitamin B-12, zinc, and potassium; 17 percent of the total supply of vitamin A; and 16 percent of the total supply of magnesium.

Milk and milk products also provided almost one-fourth of the total saturated fat in the food supply from 1970 to 1994. With the shift to reduced-fat, lowfat, and fat-free milks, the consistency in the contribution of saturated fat from dairy foods over the period results from the increased use of cheeses (especially in pizza, cheeseburgers, and other fast foods) and cream products.

Many Diets Calcium-Deficient

A significant expansion of the research base and an increased understanding of nutrient requirements and food components in the 1990's have prompted increases in recommended intakes for calcium to levels greater than the 1989 RDA's and the level currently provided in the U.S. per capita per day food supply.

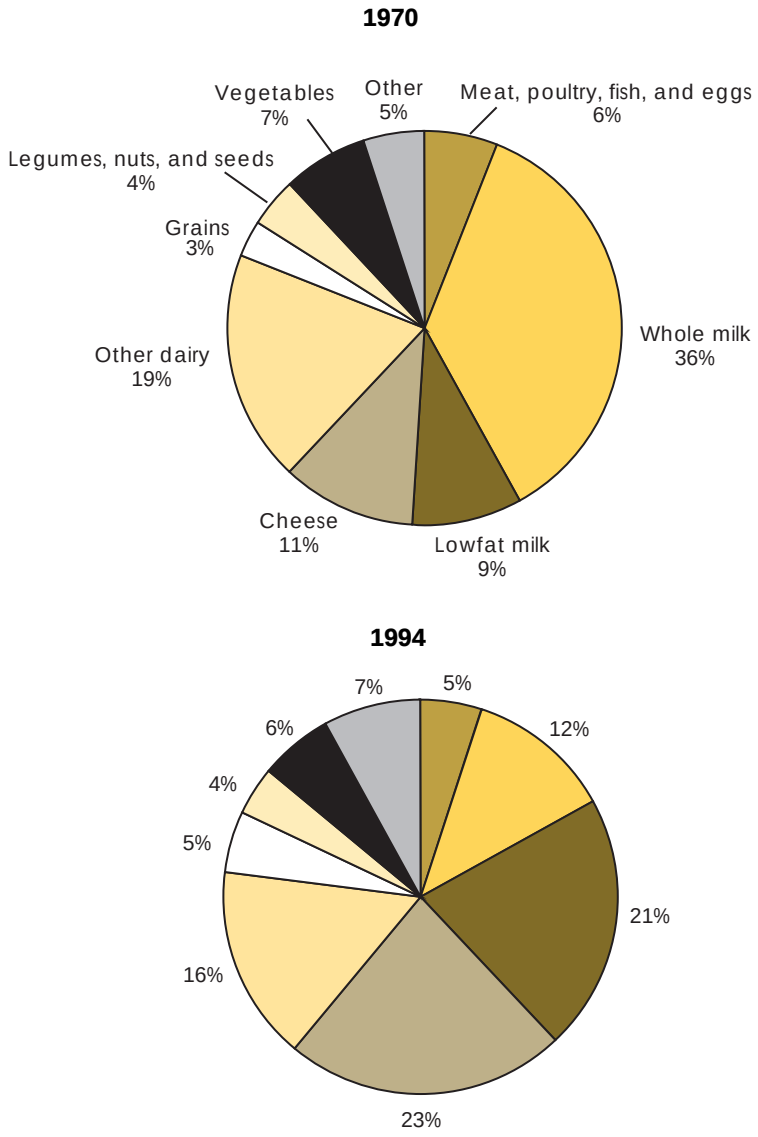
In 1994, a National Institutes of Health (NIH) Consensus Development Conference on Optimal Calcium Intake recommended that the RDA for calcium—currently 800 milligrams daily for most adults 25 years of age and over—be upgraded to between 1,000 and 1,500 milligrams, depending on age and other health factors, to help reduce the risk of osteoporosis (table 2).

The RDA's, first developed in 1941 and periodically updated, are being replaced by the IOM's new recommendations, called Dietary Reference Intakes (DRI's). Unlike the RDA's, which were initially established to protect against diseases, like rickets, caused by nutrient deficiencies, the DRI's aim to optimize health by also minimizing the risk of major chronic diseases, such as osteoporosis.

Calcium intakes recommended by the IOM are increased to at least 1,000 milligrams a day (that is the approximate amount in three-and-a-third servings of milk or other dairy foods) for all Americans over 8 years of age. Higher calcium intakes are recommended for adults over 50 years (1,200 milligrams per day, or 4 servings) and for preteens and teenagers ages 9 through 18 years (1,300 milligrams per day, or a little more than 4 servings).

The 1994 food supply provided an average 960 milligrams of calcium per person per day. Of that 960 milligrams, ERS estimates that 280 were lost to milk spill, plate waste, and discard of soured milk, moldy cheese, yellowed broccoli, calcium-rich edible bones in canned salmon, and the like. The net/residual amount (total minus spoilage and waste) would put dietary intake of calcium in 1994 at about 680 milligrams per person per day, a level well below the population-weighted

Figure 1
Sources of Calcium in the U.S. Food Supply, 1970 and 1994



averages that would have been required to meet the intake recommendations of the NIH Consensus Development Conference on Optimal Calcium Intake (1,180 milligrams), the IOM (1,040 milligrams), or even the 1989 RDA's (870 milligrams).

Many Americans are not consuming calcium in the amounts that are currently being suggested by health experts. According to USDA's Continuing Survey of Food Intakes by Individuals (CSFII), Americans 2 years of age and over consumed an average of 1.5 servings a day of dairy foods in 1994-96, instead of the two to three servings a day recommended by USDA's Food Guide Pyramid. The 1994 CSFII shows that only children ages 2-5 years met their calcium-intake goal, consuming an average of 128 percent of their DRI values for calcium. Men's calcium intakes fell below their respective DRI values. Calcium intakes for men were 63 percent of the DRI for men over 65 years, 88 percent of the DRI for men ages 18 to 65 years, and 90 percent of the DRI for those ages 12 to 17 years. Women's calcium intakes fell even further below their DRI values. Their calcium intakes were 48 percent of the DRI for women over 65 years, 61 percent for women ages 18 to 65 years, and 63 percent for those ages 12 to 17 years.

What Americans Can Do To Increase Calcium Intakes

Substantial changes in dietary patterns need to be made to ensure adequate calcium intake and optimal bone health. People should try to get as much calcium from food as possible. Including recommended amounts of calcium-rich foods—especially milk and milk products along with dark-green leafy vegetables—and calcium-fortified juices, cereals, and bread products in a balanced and varied diet is the preferred approach to attaining recommended calcium intake. Supplements are warranted for people who are unable to get the recommended amounts of calcium through diet alone.

Food selection practices in the United States make it difficult to meet calcium needs without milk and milk products in the daily diet. Even though most people know that milk is a leading source of calcium, and that calcium is important for health, they do not get enough—whether they mistakenly believe that they are getting enough calcium or their bodies cannot tolerate milk. Other reasons causing some to fall short of the recommendations for calcium include taste preferences for low-calcium foods, fat and weight

concerns, family and peer influence, and food choices made while eating away from home (see "Popularity of Dining Out Presents Barrier to Dietary Improvements," elsewhere in this issue).

Milk and other dairy products are the most concentrated source of calcium. Milk not only provides calcium, but it is also fortified with 100 IU of vitamin D per cup. Vitamin D stimulates calcium absorption. Vitamin D occurs naturally in such animal products as fatty fish like salmon, eggs, liver, and butter. Besides milk, some bread products and cereals are fortified with vitamin D. Milk and yogurt are also good sources of magnesium, a mineral used in building bones. Magnesium intakes tend to be low in relation to recommendations, and there are not that many foods that are really good sources. Not only does calcium-rich milk contain many other important nutrients, the calcium it delivers may be less likely to lead to kidney stones than the calcium obtained from supplements.

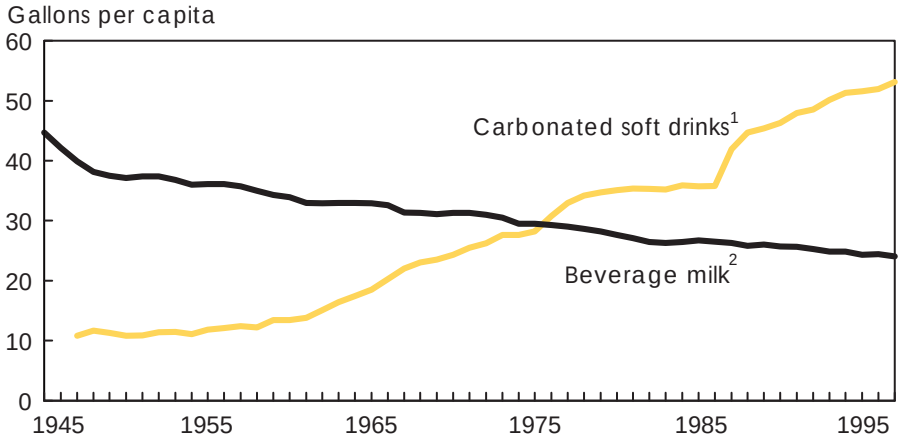
Whole milk products, however, are also concentrated sources of fat, and should be consumed in moderation. The solution is to consume adequate amounts of lowfat dairy products—such as 1-percent or nonfat milk, lowfat or nonfat yogurt, and lower fat cheeses, such as partskim mozzarella and ricotta—all of which are just as high, if not higher, in calcium than their high-fat versions. Consumers also need to be more concerned about the nutritional value of their selections when eating away from home, especially of the calcium-rich foods on the menu, and make more appropriate food choices.

About 25 percent of adults in this country may have trouble digesting lactose, the most abundant sugar in milk. Lactose intolerance is especially common in African Americans, Hispanics, Native Americans, and Asian Americans. Studies reveal that an 8-ounce glass of milk, particularly if taken with a meal, should not cause problems for most people with lactose intolerance. Cheeses aged at least 6 months; yogurt with "live active" cultures; and foods with small amounts of lactose, such as cottage cheese and soft cheeses, are also well tolerated. In addition, lactose-free dairy products are available. There are also good nondairy sources of calcium: white beans, almonds, broccoli, canned salmon and sardines eaten with the bones; dark leafy greens, such as kale and arugula; fortified cereals; clams; tofu (bean curd) made with calcium sulfate; and calcium-fortified orange juice and breakfast cereals. Other foods, while by no means considered good sources, do contribute some calcium to the diet. For example, 1 cup of cooked carrots contains 48 milligrams of calcium, and one orange has 52 milligrams.

Consumers' preference for carbonated beverages and the concern about extra calories and dietary fat by many women are important factors in the decreased consumption of fluid milk since the 1970's. On any given day, half of all Americans drank carbonated soft drinks in 1994-96, according to the CSFII. Food intake survey data indicate that the intake of both regular and low-calorie soft drinks has increased dramatically since the 1970's. The increase is highest among teenagers and younger adults, with women drinking more low-calorie drinks. Annual food supply data show that per capita consumption of regular carbonated soft drinks increased from 22 gallons in 1970 to 40 gallons in 1994 and to 41 gallons in 1997, while that from diet drinks increased from 2 gallons in 1970 to 12 gallons in 1994 and 1997. (If only half the population drinks soda on any given day, as indicated by recent food intake surveys, than soda drinkers would consume more

Figure 2

In 1945, Americans Drank More Than Four Times as Much Milk as Carbonated Soft Drinks; In 1997, They Downed Nearly Two and a Half Times More Soda Than Milk



Notes: [1]1947 is the earliest year for which data on soft drink consumption are available. [2]Per capita consumption of milk reached an all-time high in 1945 (data series dates from 1909).

of the available supply of soda than the per capita food supply data suggest.) By comparison, annual per capita consumption of beverage milks declined from 31 gallons in 1970 to 25 gallons in 1994 and to 24 gallons in 1997.

Excessive alcohol intake can also compromise calcium status by reducing the intestinal absorption of calcium as well as decreasing its dietary intake by replacing fluid milk consumption. "Excessive" alcohol intake is defined in the *Dietary Guidelines for Americans* as more than one drink (12 ounces of regular beer or 5 ounces of wine) a day for women and more than two drinks a day for men.

Although all people should try to meet their calcium needs through their diet, many people (especially older adults) may need a boost from supplements. In fact, a study done at the Jean Mayer USDA Human Nutrition Research Center on Aging (HNRCA) at Tufts University concluded that the NIH consensus panel's calcium recommendations for people over age 50 are probably too hard for most people to meet, and so a daily supplement is recommended for those people. Researchers at the HNRCA at Tufts have devised a Food Guide Pyramid for people ages 70 and over. A flag at the top of this pyramid is a reminder that supplements—calcium, vitamin D, and vitamin B-12—may be necessary. This is especially true for those with low food intake/caloric requirements, low consumption of milk products, poor absorption of those three nutrients, and limited exposure to sunlight.

Calcium carbonate and calcium citrate are the best supplement choices. Calcium carbonate compounds such as Caltrate, Os-Cal, and Tums are generally the most economical and convenient supplements to use. Each pill usually contains at least 200 milligrams of calcium at a cost of as little as $2 per month for some generic brands. However, about 20 percent of those over age 60 and 40 percent of those over age 80 may not produce enough stomach acid to promote sufficient absorption of calcium carbonate between meals. Therefore, calcium carbonate should always be taken with either food (which stimulates the secretion of stomach acid) or orange juice (which has a high acid content) to be certain that the calcium is absorbed by the body. Calcium citrate (Citracal and others) is easier to absorb than calcium carbonate, but consumers have to take more of it, and it is usually more expensive.

Promotions and New Products Buoy Consumption

To help consumers include more dairy products in the diet, a number of promotional campaigns have been developed by the Federal Government, private and public dairy interests, and health professionals. Some of these activities target specific groups of Americans to improve intake of dairy products overall; others are more focused on the nutrient contributions and the link to health. However, the basic goal of each campaign is to promote dairy product consumption. Cooperative advertising efforts by dairy farmers and processors appear to have boosted milk and cheese sales (see "Advertising's Influence: The Case of Dairy Products," elsewhere in this issue).

Recent publicity about how people in this country are not consuming enough calcium and could end up more vulnerable to broken hips and spines has encouraged food marketers to add calcium to dairy products, even though they are already the main source of calcium. Since release of the IOM report in 1997 calling for Americans to consume more calcium, Dannon stepped up the marketing of its new calcium-fortified yogurt. Kraft Foods' new Light and Lively cottage cheese contains double the amount of calcium normally found in cottage cheese. After falling 15 percent in 1996, sales of Edy's (sold as Dreyer's west of the Rocky Mountains) frozen yogurt in 1997 held steady after the company quintupled the amount of calcium in a serving—and promoted the fact. In 1998, Safeway Stores, Inc., introduced its Lucerne brand Skim Delux Fat Free Milk (a calcium-fortified product with 66 percent more calcium than whole milk). Skim Delux currently (April 1999) sells at a 20-cent-per-half-gallon premium over the price of Lucerne regular skim milk in the Washington, DC, area. One cup of Skim Delux Fat Free Milk provides 80 calories, 0 grams of fat, 8 grams of protein, and 500 milligrams of calcium (50 percent of the recommended calcium intake for adults age 19 through 50 years). Some marketers of breakfast cereals, waffles, and orange juice have also fortified their products with calcium.

Public Health Strategies To Implement Calcium Intake Recommendations

Optimizing the calcium intake of Americans is of critical importance. Surveys show that a large percentage of Americans fail to meet currently recommended guidelines for calcium intake. The impact of suboptimal calcium intake on the health of Americans and the health care

cost to the American public is a vital concern. The 1994 NIH Consensus Statement on Optimal Calcium Intake called for a unified public health strategy to ensure optimal calcium intake in the American population. Such a strategy should have a broad outreach and should involve educators, health professionals, and the private and public sectors. Things to look forward to as research and technology advance:

- Development of guidelines for calcium intake that are consistent across all Government agencies, departments, and institutions and that reflect the current state of scientific knowledge;
- Development of effective health-promoting programs to change population behavior with respect to calcium intakes that are tailored to specific age, sex, ethnic, socioeconomic status, and regional needs;
- Food manufacturers and producers continuing to develop and market a wide variety of calcium-rich foods to meet the needs and tastes of our multi-ethnic population;
- Restaurants, grocery stores, and other food outlets increasing the accessibility and visibility of calcium-rich products for the consumer;
- Development of cost-effective means by which calcium-deficient individuals can be identified at all ages; and
- Continued monitoring and dissemination of data and information on nutrient intakes and food consumption patterns with respect to calcium intake.

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Food Companies Spread Nutrition Information Through Advertising and Labels

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The question of how best to get evolving scientific evidence linking diet and disease to consumers has been much debated. At issue are widely varying opinions about how effective food manufacturers are in reaching consumers, compared to, or in addition to, Government and other information sources, and about the best approaches for controlling misleading or deceptive claims.

The Federal Government has published information on the link between diet and health—particularly heart disease and certain cancers—and promoted dietary recommendations to reduce the risk of disease since the mid-1970's. Private health organizations, such as the American Heart Association and the American Cancer Institute, have also devoted significant resources to informing the public of these diet-disease risks beginning even earlier. Yet despite the efforts of Government and other general information sources to communicate the links, the typical American diet still deviates substantially from recommendations, although it has certainly improved since the mid-1960's. While we cannot conclude that current consumption patterns reflect a lack of information about diet and health (since many consumers may knowingly trade long-term health costs for taste and other things they value), Americans' eating habits raise the likelihood that public-education campaigns have not been fully successful.

Allowing truthful diet-disease claims by food manufacturers likely benefits consumers, since this policy increases the opportunity, and thus the competitive pressure on companies, to market the nutritional features of foods. Also, if manufacturers' claims are an important source of information for many consumers, a greater freedom to make valid claims could spread the information more effectively to a larger portion of the population.

We use the experience in the ready-to-eat cereal market and consumption trends from surveys and food supply data to evaluate whether policy changes that took place in the mid-1980's—which allowed food manufacturers to explicitly link diet to disease risks through health claims in advertising and labeling—appear to have improved consumers' food choices or, as many critics fear, to have confused consumers sufficiently to slow improvements in diet that would otherwise occur.

Previous Regulations Constrained Diet-Disease Information

Claims on food labels are primarily regulated by the U.S. Food and Drug Administration (FDA), and claims in advertising are primarily under the jurisdiction of the Federal Trade Commission (FTC). Labels on meat and poultry products are regulated by the U.S. Department of Agriculture (USDA). Food manufacturers' claims linking fiber, fat, cholesterol, or any other dietary component to disease risks were explicitly prohibited on FDA-regulated labels throughout the 1970's and into the 1980's. Thus, for instance, from 1973 to the mid-1980's a manufacturer could label the fiber, fat, saturated fat, and cholesterol content of a food product but could not on the label cite the health reasons why consumers should care about these characteristics, namely, the potential to reduce heart disease and cancer risks.

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The rules for advertising were different, in that they never formally prohibited diet-disease claims, though the labeling policy raised the risk that such a claim in advertising would be judged deceptive. The FTC allowed simple nutrient claims about fats and cholesterol throughout this period, as long as the claim was not deceptive or misleading.

The policy banning health claims on labels, with its implications for advertising, was effectively relaxed in 1985 following the introduction of Kellogg's highly publicized advertising and labeling campaign for its All-Bran cereal. This campaign explicitly used the National Cancer Institute's statements on the potential relationship between fiber and cancer prevention to promote Kellogg's high-fiber cereals. The FDA's decision not to challenge this prominent campaign presumably led firms to perceive a significantly reduced legal risk in using accurate and well-founded health claims in advertising and labeling.

Initial claims focused on the relationship between fiber and cancer, but a number of food manufacturers soon began to promote the relationship between saturated fat and cholesterol consumption and heart disease. For instance, Promise margarine, which was lower at the time in saturated fat than margarines were, was introduced in 1986 with its "Heart smart" theme and focus on the role of saturated fat in coronary disease risks. A major TV campaign by Nabisco for Fleischmann's lower saturated fat margarine, featuring a 30-year-old man talking about his recent heart attack and discussing the role of diet in prevention, also ran in 1986. By 1987, a number of firms had major advertising campaigns touting the role of a diet low in saturated fat in reducing the risk of heart disease.

Manufacturers' Health Claims Boosted Sales of High-Fiber Cereals . . .

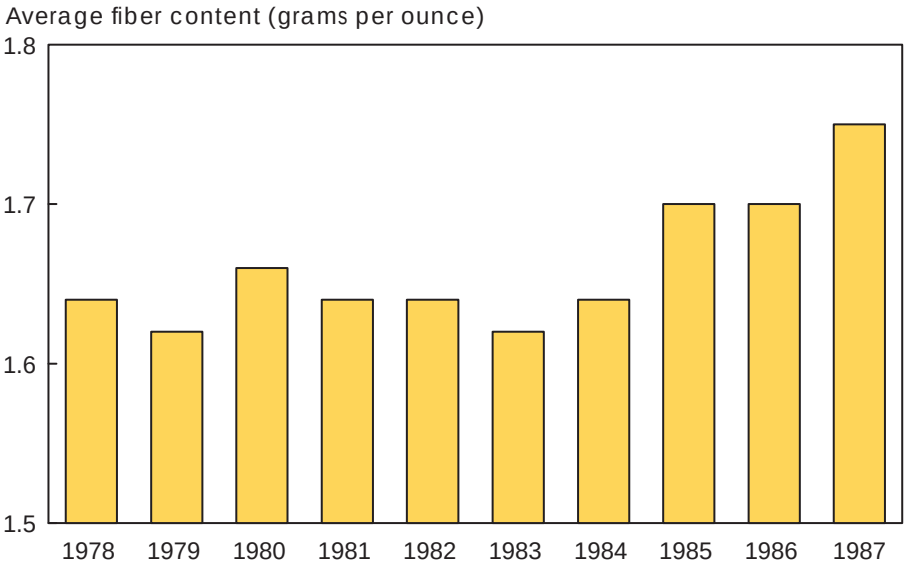
Despite growing evidence on the link between reduced cancer rates and high-fiber diets during 1978-84, a period before health claim advertising, there was no shift toward high-fiber cereals (fig. 1). However, as soon as health claims in advertising and labeling began in late 1984, there was a significant increase in the market-share-weighted fiber content of cereals (grams of fiber per ounce). During 1985-87, the market-share-weighted fiber content of cereals rose from 1.64 grams to 1.75 grams, an increase of approximately 7 percent. We estimate that health claims in advertising and labeling may have caused approximately 2 million more households to consume high-fiber cereals during these 3 years and, thus, led individuals in those 2 million households to reduce their risk of colon cancer.

Cereal manufacturers, in response to the growing demand for high-fiber cereals and knowing they could now advertise the health benefits of fiber, responded by developing new high-fiber cereals. Excluding children's cereals, cereals introduced between 1985 and 1987 averaged 3.59 grams of fiber per ounce, compared with an average of 1.99 grams of fiber per ounce for cereals introduced between 1978 and 1984.

It is important to note that prior to 1984, firms were permitted to disclose their fiber content on labels. Consequently, the dramatic effects on food manufacturer and consumer behavior appear to be linked to the use of the health claim rather than the ability to list the fiber content. In other words, it is important to permit firms to explain the reasons why consumers should care about fiber.

Researchers at FDA also found substantial effects on cereal sales following the start of the Kellogg Company's All Bran advertising campaign. They examined weekly sales data from a Washington, DC, grocery chain for a 48-week period that began 14 weeks prior to the

Figure 1
Fiber Content of Cereals Rose After Health Claims Began



Kellogg campaign. The size, distribution, and timing of cereal sales' increases supported the conclusion that the introduction of the health-claim advertising in the cereal market had a clear and substantial effect in shifting consumer purchases toward higher fiber cereals.

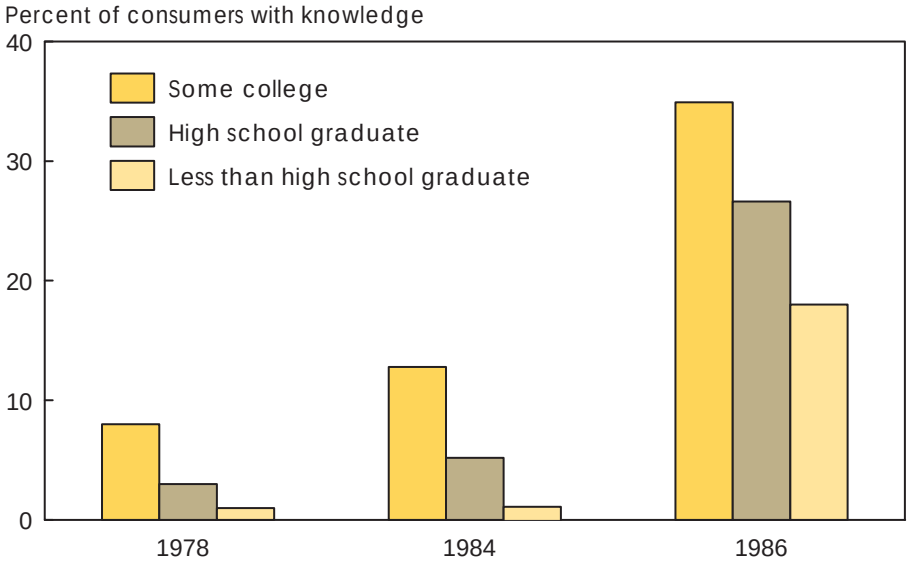
. . . And Consumers' Knowledge of the Link Between Dietary Fiber and Cancer Prevention

The use of health claims in the ready-to-eat cereal market also profoundly affected consumers' knowledge of the link between fiber consumption and cancer (fig. 2). FDA survey data show that consumer knowledge of the link was low and did not increase substantially in the 6 years before the introduction of health claims on labels and in advertising. For consumers with education levels below high school, there was no gain in knowledge, and for high school graduates and those who attended some college, there were some modest gains.

For example, in 1984 (as in 1978), only 1 percent of those with less than a high school education knew of the link between fiber and cancer. After the introduction of health claims, all groups gained knowledge of the fiber-cancer link. For example, reported knowledge rose from 1.1 percent in 1984 to 18 percent in 1986 for those with less than a high school education. Knowledge levels also increased dramatically for other education groups.

In considering potential reasons why advertising had different effects than other information sources in the period prior to the introduction of health claims, several major differences between the distribution methods used by Government and private advertisers

Figure 2
Fiber-Cancer Knowledge Grew After Health Advertising



are worthy of mention. Government and general information is usually disseminated in generic form ("increased soluble fiber consumption may reduce risks of coronary heart disease"), and this information is concentrated in news and print media reports about the latest scientific studies on diet and health. Researchers have found that more educated consumers are more likely to acquire nutrition information from print media than are their less educated counterparts. Also, generic information requires that consumers have other sources of information and a better understanding of the underlying disease issue to turn the information into behavior, creating a potential bias toward those most efficient in processing information and those with better access to health information.

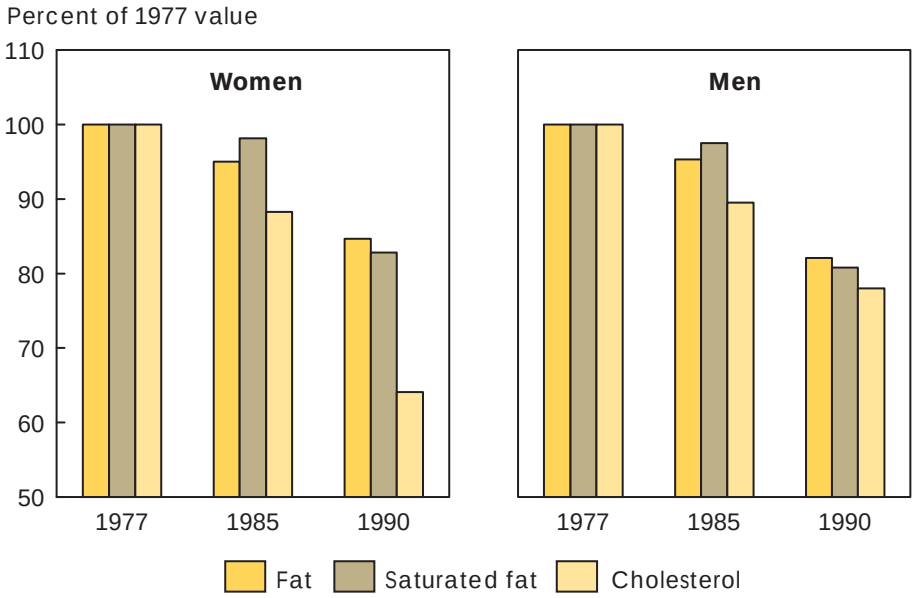
In contrast, most cereal advertising is distributed through television, with a smaller portion in print media. Moreover, health-claim advertising and labeling is product-specific, so that advertising and labeling not only indicates the relationship between food characteristics and health, but also prominently features a product that contains these characteristics.

Surveys Show Daily Intake of Fats and Cholesterol Falling

USDA periodically conducts large national surveys in which detailed information on all foods and beverages consumed over a previous 24-hour period are collected and matched to nutrition data. Samples of male and female heads of households were consistently questioned in all these surveys. For these samples, the surveys show that average intakes of fat, saturated fat, and cholesterol for both women and men declined during 1977-90, and the rate of decline was generally greater between 1985 and 1990, the period when diet-disease claims were permitted.

Average daily fat intake (measured as a percentage of the 1977

Figure 3
Intake of Fat, Saturated Fat, and Cholesterol Fell Faster After 1985



Note: Data are for women and men ages 19-50 years.

intake level) for both men and women fell during 1977-85, and the rate of decline accelerated during the health claims period of 1985-90 (fig. 3). Average daily fat intake for women declined significantly by 3.7 grams in the 8 years from 1977 to 1985 (from 73.3 to 69.6 grams), and fell an additional 7.5 grams in the nearly 5 years between 1985 and 1990. For men, daily fat intake in declined by 5.3 grams during 1977-85 (from 112.8 to 107.5), and fell an additional 14.9 grams in 1985-90.

Movements in saturated fat intake generally parallel changes in total fat intake (fig. 3). (Saturated fat and cholesterol nutrition data are not available for foods in 1977, so 1977 consumption is paired with nutrition data from 1985 to measure intake of these food components.) As with total fat, the reductions in saturated fat intake were larger in the health claims period of 1985-90 than before 1985. For women, average daily saturated fat intake dropped by 1.0 gram during 1977-85, and an additional 3.5 grams during 1985-90. For men, average daily saturated fat intake declined by 1.0 gram between 1977 and 1985, and fell an additional 6.7 grams during 1985-90.

Changes in average cholesterol intake mirror those for fat and saturated fat (fig. 3). For women, these data show the same pattern of accelerated decline during the health claims period. The magnitude of the acceleration is more pronounced, though an official change in the measured cholesterol content of eggs beginning in the 1987 data suggests the need for caution in interpreting this result, since at least part of the accelerated decline is due to the lowered cholesterol content of eggs. For women, daily intake of cholesterol declined 40.4 milligrams (from 345.3 to 304.9) during the 8 years prior to 1985, and 83.7 milligrams during 1985-90.

For men, the decline in average cholesterol intake is similar, but not as accelerated during the health claims period. Daily intake of cholesterol fell 52.3 milligrams (from 498.9 to 446.6) before 1985, and an additional 57.6 milligrams between 1985 and 1990.

These declines in average intakes of fat, saturated fat, and cholesterol are consistent with the hypothesis that the policy changes that allowed food companies to mention diet-disease issues in advertising and labeling added information to the market and led to a faster rate of improvement in consumers' diets. This type of data cannot establish that advertising and labeling claims were responsible for the increased rate of dietary improvement, since, for example, Government and other public and private organizations also continued their efforts to inform the public during this period and could have found more effective ways to accomplish their goals. Nonetheless, these data provide no support for the view that the introduction of food manufacturers' health claims adversely affected overall consumer food choices or led consumers to reverse dietary improvements that were underway. Moreover, the data are consistent with the hypothesis that these claims, and the competition they spurred among food manufacturers, helped consumers to improve their diets more rapidly during the period when companies were freer to explain why these nutritional characteristics are important.

Food Supply Trends Also Show Declines in Higher Fat, Higher Cholesterol Foods

Trends in per capita consumption derived from U.S. food supply data also support the theory that Government and general sources of diet-health information affected consumers' food choices prior to 1985, and that the change in the regulations governing health claims in

1985 provided an additional source of this information, with a corresponding incremental effect on consumption patterns.

We examined trends in per capita consumption of red meat, eggs, and animal fats (primarily butter and lard), as well as those in lower fat categories, such as flour and cereal products, fruits, and vegetables. Health claims had never been allowed on meat and poultry labels, which are regulated by USDA. Thus, any effects in these categories due to the change in health claims policy would be the result of general improvements in information from claims for other foods, rather than to the direct effect of health claims on labels for lean meats and poultry.

Changes in per capita consumption of each food group were analyzed for 1977 to 1985 (prior to health claims) and for 1985 to 1990 (the health claims period). We examine these trends from a statistical perspective, using simple regression techniques that allow us to look at underlying trends and any changes in those trends as the health claim rules changed. A trend for a particular food group does not by itself establish the role of health claims in changing consumers' food choices, because changes in prices, incomes, and other factors could also have an influence. However, a pattern of similar trends across several foods suggests a stronger link between consumption changes and the ability of food companies to make health claims, since potential confounding factors are not likely to have similar effects across multiple food categories.

Per capita consumption of red meat—a major source of fat and saturated fat in the U.S. diet—declined during both the 1977-85 period and the 1985-90 period (fig. 4). In 1977, per capita consumption of red meat was 132.2 pounds per year, and by 1985 it had fallen 7.3 pounds to 124.9 pounds per year. In the next 5 years, however, the decline accelerated. Per capita consumption of red meat fell 12.5 pounds to a total of 112.4 pounds. Regression results indicate that there was a significant negative trend in meat consumption throughout 1977-90, and that the rate of decline accelerated during the health claims period.

Figure 4
Consumption of High-Fat Foods Decreased Faster After 1985

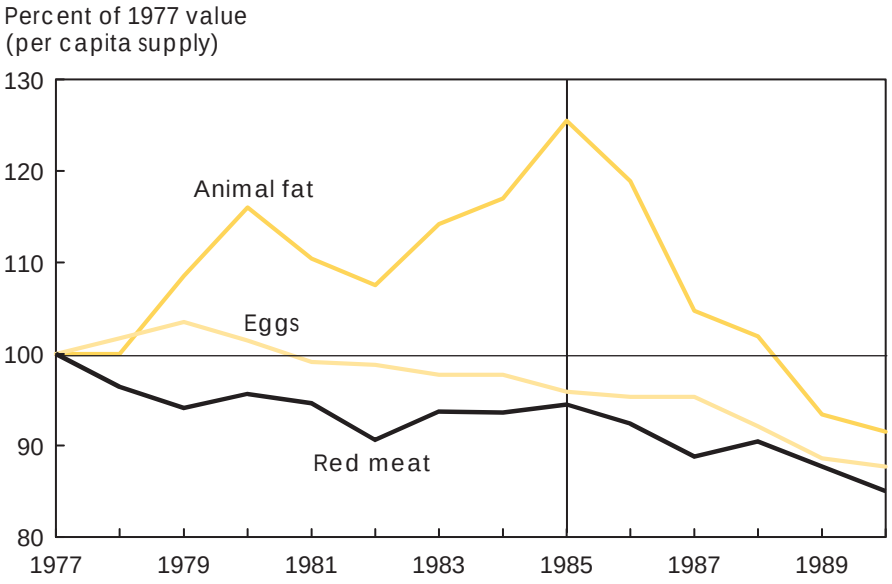
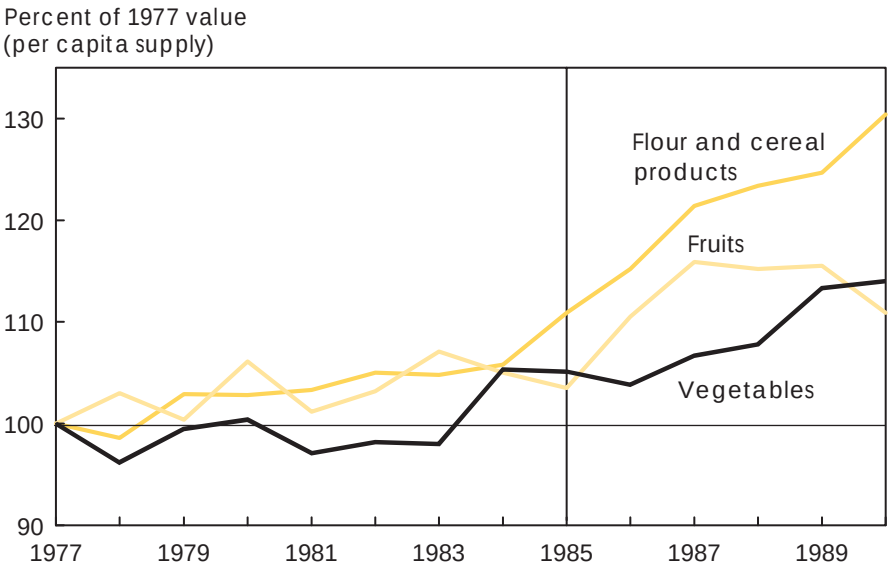


Figure 5
Consumption of Lowfat Foods Increased Faster After 1985



Per capita consumption of eggs also declined during both periods. In 1977, per capita consumption of eggs was 34.3 pounds. By 1985, this had declined by 1.4 pounds to 32.9 pounds. During the next 5 years, per capita consumption fell an additional 2.8 pounds, again showing an acceleration in the rate of decline. Regression results confirm that there was a significant negative trend during 1977-90, and that the negative trend accelerated during the health claims period.

Surprisingly, per capita consumption of animal fat rose dramatically from 1977 to 1985, and then fell as dramatically during 1985-90 (fig.4). Per capita consumption of animal fat was 10.6 pounds per year in 1977 and 13.3 pounds in 1985, a rise of 2.7 pounds. By 1990, per capita consumption had fallen to 9.7 pounds per year, a remarkable reduction of 3.6 pounds (a 27-percent reduction) in just 5 years. Regression results indicate that there was a significant upward trend in the per capita consumption of animal fat, but that this trend was reversed during the health claims period.

In each of the three cases analyzed here, per capita consumption of high-fat, high-cholesterol foods declined during the health claims period. Moreover, this decline was more accelerated compared with the earlier period when companies were prohibited from using health claims. In other work where we examined 10 high-fat foods (red meat, eggs, cream products, cheese, animal fats, vegetable fats, whole milk, butter, ice cream, and creamed cottage cheese), all showed similar accelerated declines during 1985-90. Six of the 10 high-fat foods had positive consumption trends before 1985, contrary to what would be expected if dietary information was successfully spreading to consumers.

While consumption of high-fat foods decreased in the health claims period, per capita consumption of flour and cereal products, fruits, and vegetables increased during both periods, and the rate of increase accelerated during the health claims period (fig. 5). These are major categories of foods recommended for increased consumption to replace fats in the U.S. diet.

For example, between 1977 and 1985, annual per capita consumption of flour and cereal products increased by 15.4 pounds (from 140.7 to 156.1). In the next 5 years, consumption rose another 27.4 pounds to 183.5 pounds per capita. For vegetables, consumption rose 10.3 pounds (from 200.5 to 210.8) between 1977 and 1985, and rose 17.6 pounds between 1985 and 1990. Consumption of fruits rose 3.4 pounds (from 96.1 to 99.5) between 1977 and 1985, and rose 7.1 pounds between 1985 and 1990. Regression results confirm that the upward trend was statistically significant for all three categories, and that this trend accelerated significantly during the health claims period for flour and cereal products, and for vegetables. The trend also increased for fruits, but not significantly. In other work where we examined eight low-fat food categories (poultry, fish, skim milk, flour and cereal products, vegetables, fruits, lowfat cottage cheese, and ice milk), six showed accelerated rates of increase during 1985-90.

Market-share data in the ready-to-eat cereal market, consumer knowledge data, individual nutrient intake data, and per capita consumption data all indicate that diets improved after food manufacturers were permitted to use health claims in advertising and labeling. Moreover, evidence from the ready-to-eat cereal market suggests that allowing companies to use health claims resulted in more healthful product innovations and provided companies with incentives to compete on the health features of their products.

The evidence presented here is consistent with the argument that food manufacturers' claims have significant potential to increase consumer awareness of diet-health issues and to improve consumer dietary choices, especially for groups not well reached by Government and general sources of information. For these reasons, health claims policy should be designed to ensure that food companies' incentives to make truthful health claims in advertising and labeling are preserved.

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Advertising's Influence: The Case of Dairy Products

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In the early 1980's, dairy farmers were producing more milk and dairy products than Americans were consuming. Part of the surplus was due to high Government dairy-support prices which kept milk production high, and part was due to declining consumption of dairy products among consumers. For example, between 1970 and 1983, per capita consumption of fluid milk declined from about 269 pounds per year to about 227 pounds. During the same period, per capita cheese consumption declined from about 5 pounds to 4 pounds. Even per capita consumption of frozen dairy products fell from 28 pounds to 27 pounds per year over the same period. Part of the decline in the consumption of dairy products, particularly milk, was from the intense competition of soft drinks, fruit drinks, and other noncarbonated drinks aimed at adolescents and young adults.

To stem the continuing decline in dairy product consumption, many dairy farmers participated in local advertising campaigns to promote the positive benefits of dairy products. Advertising is directed toward existing and potential consumers of a product with the objective of increasing sales. Some campaigns were conducted by individual dairies, but more commonly, groups of dairy farmers joined together in generic advertising efforts. Brand advertising promotes the particular characteristics of a given product brand, while generic advertising promotes consumption of the general commodity.

Generic advertising is used by a cooperative, or group of producers, to promote products that are essentially homogenous—one dairy farmer's 2-percent, reduced fat milk differs little from another farmer's. Because a generic message promotes a type of food or commodity, all producers in the industry benefit from the generic campaign, including "free riders" who do not contribute funds for the advertising campaign. A successful generic advertising campaign will generally increase both the quantity sold of the commodity and the price paid by the consumer.

Two National Dairy Advertising Programs

With the surpluses of the 1980's, dairy farmers and government officials recognized the need for an inclusive and mandatory approach to generic advertising in order to reduce surpluses and increase the consumption of dairy products. Mandatory programs are often established for fairness reasons, to ensure everyone who benefits shares in the cost.

Congress passed the Dairy Production Stabilization Act of 1983 (known as the Dairy Act), which established a national program to increase consumption of milk and dairy products and reduce milk surpluses. This self-help program is funded by a mandatory 15-cents-per-hundredweight assessment on all milk produced in the contiguous 48 States and marketed commercially by dairy farmers. It is administered by Dairy Management Incorporated (DMI), which is run by a board made up of dairy farmers to oversee the generic advertising campaigns.

Dairy farmers can direct up to 10 cents per hundredweight of the assessment for contributions to qualified regional, State, or local dairy product promotion, research, or nutrition-education programs for milk, cheese, butter, ice cream, and other dairy products. The remaining 5 cents must go to DMI for national generic advertising. DMI concentrates on generic advertising for milk and cheese. In 1996, $76.5 million was collected under the Dairy Act—a substantial increase over the $18.5 million spent on generic advertising in the year prior to the Dairy Act.

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Table 1
Generic Dairy Advertising Boosts Milk and Cheese Sales

Item	Unit	1995	1996
Total milk advertising expenditures	*million dollars*	56.4	70.5
Fluid milk sales	*billion pounds*	23.3	23.5
Sales gain due to Acts	"	1.5	1.4
Gain in sales	*percent*	6.3	5.9
Total cheese advertising expenditures	*million dollars*	50.0	30.9
Cheese sales (natural and processed)	*million pounds*	1,931.2	2,250.8
Sales gain due to Act	"	45.9	62.7
Gain in sales	*percent*	2.0	2.3

Notes: Data for milk are for 12 U.S. milk marketing orders, while cheese figures are national. 1995 covers the period October 1994 to September 1995. 1996 covers the period October 1995 to September 1996.

The Fluid Milk Promotion Act of 1990 (called the Fluid Milk Act) established a second and separate dairy promotion and education program through an assessment on milk processors of 20 cents per hundredweight for fluid milk processed and marketed in the United States. All milk processors who market more than 500,000 pounds of fluid milk per month must participate. The program is designed to strengthen the position of the dairy industry in the marketplace and to expand the consumption of fluid milk products in the United States. Advertising under this program is strictly for fluid milk and concentrates on print media. Current ads feature a celebrity sporting a milk moustache and a message informing the public about the nutritional qualities of milk. In 1996, approximately $100 million was collected for the milk moustache campaign.

Milk Sales 6 Percent Higher With Advertising

USDA's Economic Research Service (ERS) and Agricultural Marketing Service are currently evaluating the effectiveness of two national and associated regional programs of generic dairy advertising. ERS examined the effect of generic advertising on fluid milk sales in 12 milk marketing regions (representing about 43 percent of the U.S. population) before and after the Dairy Act became law. The pre-Dairy-Act period includes December 1978 through August 1984. The post-Dairy-Act period begins in September 1984 (the month when advertising funds were first spent for fluid milk promotion) and runs through September 1996. Promotion expenditures in 1995 and 1996 also include the revenue collected under the Fluid Milk Act.

The analysis assumed that without the Acts, the dairy industry would have maintained advertising at $18.5 million per year (the expenditure the year before implementation of the Dairy Act). Together, the Dairy and Fluid Milk Acts accounted for an estimated $179 million in additional fluid milk advertising expenditures in the 12 regions from September 1984 through September 1996. ERS research suggests that during this 12-year period, the additional advertising contributed to an estimated 17-billion-pound increase in fluid milk sales (about 6 percent of total sales) in the 12 regions. (A gallon of milk weighs approximately 8.6 pounds.)

Fluid milk sales in the 12 regions totaled about 24 billion pounds during October 1995 to September 1996, the most recent 12-month period for which data are available. The $52 million in increased advertising expenditures due to the Acts during October 1995 to September 1996 is estimated to have increased sales by 1.4 billion pounds of milk, or almost 6 percent of total sales. Although the ERS analysis takes into account the effect of changes in prices, income, population, demographics, and advertising, ERS's analysis does not control for changes in consumer preferences, such as increased public concern about osteoporosis and the role calcium intake plays in lessening or preventing this condition. Factors such as this may have also contributed to increased milk sales following the Dairy and Fluid Milk Acts.

Generic Advertising Spurs Cheese Sales

The effects of generic advertising on the sales of natural and processed cheeses were evaluated separately because of their different product characteristics and consumer purchasing patterns. Data

limitations restricted the analysis to the effects of advertising on national retail sales of cheese (for home use), accounting for about a third of the total market for cheese. The remaining cheese is used in foods away from home, such as cheeseburgers and tacos at restaurants and schools, or as ingredients in processed foods, such as ravioli or frozen pizza.

Generic advertising under the Dairy Act increased total U.S. retail cheese consumption by approximately 562 million pounds, or about 2 percent of total sales, from September 1984 to September 1996. Estimated sales of natural cheeses, like cheddar, increased about 63 million pounds (0.5 percent), while processed cheese (Velveeda-type cheeses) sales increased about 499 million pounds (5.0 percent). Generic advertising appears to be more effective in increasing processed cheese sales, partly because sales of processed cheese remain higher after advertising efforts for a longer period than do natural cheese sales.

Generic advertising under the Dairy Act increased retail cheese sales by about 63 million pounds (2.3 percent of total cheese sales) during the most recent 12-month period, October 1995 to September 1996. Most of the increase was in processed cheese sales. Generic advertising increased retail sales of processed cheese by an estimated 57 million pounds, or 6 percent, and retail sales of natural cheese by an estimated 5 million pounds, or 0.5 percent.

For More Details...

Call 1-800-999-6779 to order a copy of *Evaluation of Fluid Milk and Cheese Advertising, 1984- 96*, TB-1860, by N. Blisard, D. Blayney, R. Chandran, D. Smallwood, and J.R. Blaylock, USDA's Economic Research Service, Oct. 1997.

Successful generic advertising for cheese can either influence consumers who never or rarely consume cheese to purchase some, or it can persuade current consumers of cheese to purchase more. The effects differed between the natural and processed cheese markets. A 10-percent increase in generic advertising increases the proportion of new buyers of natural cheese by a small amount (0.04 percent), but it does not affect the average quantity purchased by households that already consume natural cheese. However, that same increase in advertising increases the proportion of new buyers of processed cheese by about 3 percent, and increases the average quantity purchased by about 2 percent.

Advertising Yields Positive Returns to Producers

Assessing the returns to dairy farmers after the Dairy and Fluid Milk Acts is complex because of the economic link between consumers, processors, and dairy farmers. Many assumptions must be made about how retail prices are transmitted back to wholesale and farm prices. In addition, economic conditions, such as retail price changes and input cost increases, continue to change and to influence decisions at the farm, wholesale, and retail market levels.

Under the assumptions of this analysis, generic advertising for fluid milk and cheese has been successful for U.S. dairy farmers. As reported above, generic advertising under the Acts boosted demand for fluid milk by 6 percent during September 1984 to September 1996 and cheese by 2 percent. This higher demand boosted average farm-level milk prices almost 4 percent higher than they would have been without the advertising programs. The estimated average milk prices received by dairy farmers with and without the Acts were $13.07 and $12.59 per hundredweight, respectively. The difference between the two prices—48 cents per hundredweight—is the gross return to dairy farmers of increased advertising under the Acts. The increased milk prices compared with the 9-cent increase in the cost of advertising (15-cents-per-hundredweight contribution now required from dairy farmers minus 6 cents per hundredweight that was spent on advertising in pre-Dairy-Act days) means that dairy farmers gained more than five times their increased advertising costs (48 cents in gain versus 9 cents in cost).